
HAZARD MITIGATION PLAN



**Office of Emergency Management
10 North Main, 1st Floor
Mt. Clemens, MI 48043**

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PREFACE

Hazard mitigation is any action taken before, during, or after a disaster to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. It is an essential element of emergency management, along with preparedness, response, and recovery. There is a cyclical relationship between the four phases of emergency management. A community prepares for a disaster, and then responds when it occurs. Following the response, there is a transition into the recovery process, during which mitigation measures are evaluated and adopted. This, in turn, improves the preparedness posture of the community for the next incident, and so on. ***When successful, mitigation will lessen the impacts to such a degree that succeeding incidents will remain incidents and not become disasters.***

Hazard mitigation strives to reduce the impact of hazards on people and property through the coordination of resources, programs, and authorities so that, at the very least, communities do not contribute to the increasing severity of the problem by allowing repairs and reconstruction to be completed in such a way as to simply restore damaged property as quickly as possible to pre-disaster conditions.

Such efforts expedite a return to "normalcy." However, replication of pre-disaster conditions results in a cycle of damage, reconstruction, and damage again. Hazard mitigation is needed to ensure that such cycles are broken, that post-disaster repairs and reconstruction take place after damages are analyzed, and that sounder, less vulnerable conditions are produced. Through a combination of regulatory, administrative, and engineering approaches, losses can be limited by reducing susceptibility to damage. ***Hazard mitigation provides the mechanism by which communities and individuals can break the cycle of damage, reconstruction, and damage again.***

Recognizing the importance of reducing community vulnerability to natural and technological hazards, the County of Macomb is actively addressing the issue through the development and subsequent implementation of this plan. There are many benefits to be realized from this effort, protection of the public health and safety, preservation of essential services, prevention of property damage, and prevention of damage to the local economic base. This will help ensure that Macomb County remains a vibrant, safe, and enjoyable place in which to live, raise a family, and conduct business.

PUBLIC INVOLVEMENT

This plan is the culmination of our interdisciplinary and interagency planning effort that required the assistance and expertise of numerous agencies, organizations, and individuals. Without the technical assistance and contributions of time and ideas of these agencies, organizations, professional planners, and individuals, this plan could not have been completed.

Following is a list of key contributors to the plan who participated in advisory committees (4), public meetings (4), workshops (5), surveys (1), and personal interviews (27) that created the foundation for this plan.

Abraham	Paul	Armada Township Fire Department
Alcini	Tom	Shelby Township Emergency Manager
Alward	Gerald	Washington Township Fire Department
Beck	Robert	Utica Fire Department
Bissonnette	Bruce	Utica Police Department
Brouwer	Paul	Clinton Township Emergency Manager
Callewaert	Charles	Harrison Township Emergency Manager
Calvert	Doug	Chesterfield Township Fire Department
Carabelli	James	Truck Frame & Axle
Childs	John	Sterling Heights Fire Department
Clark	Allen	TRW
Clement	Randall	Henkel Surface
Coll	Elwin	Macomb County Environmental Health
Coyle	Michael	Mount Clemens Fire Department
Cukr	Stanley	Clinton Township Fire Department
Cuneo	Edward	Chesterfield Township Fire Department
DiMaria	James	Ray Township Fire Department
Ellis	John	Fraser Public Safety
Ernst	Al	Clinton Township Police Department
Fields	Gary	TRW
Garcia	Adam	Center Line Emergency Manager
Gasowski	Richard	Macomb County Risk Management
Getts	John	Warren Fire Department
Gurney	Keith	Center Line Public Safety
Hackel	Mark	Macomb County Sheriff Department
Hagen	Dan	Eastpointe Fire Department
Heida	Nancy	US Army TACOM
Hejza	John	St. Clair Shores Fire Department
Hickman	George	Roseville Fire Department
Hingst	Richard	Daimler Chrysler
Hula	Timothy	Carboloy Inc.
Jenks	Michael	New Haven Fire Department
Johnson	Robert	Sterling Heights Emergency Manager
Kamlay	Dr. Mitchell	US Coast Guard
Kuchenmeister	Keith	Mt Clemens General Hospital
LeGree	Fred	Roseville Fire Department
Lubeckyj	Michael	Mt. Clemens Police Department
Marcero	Larry	New Baltimore Fire Department
Materna	Stephan	Warren Emergency Manager
Meerschaert, Sr.	Ken	Macomb Township Fire Department
Mercer	Kenneth	Clinton Township Emergency Manager

Miles	Gary	Warren Fire Department
Mioduszewski	Louis	Macomb County Emergency Management
Misaros	John	WPS Energy Services
Morehouse	George	Shelby Township Fire Department
Oke	Ellen	Warren Fire Department
Oke	Gregory	Eastpointe Fire Department
Palazzola	Joe	Fraser Public Safety
Parus	William	Ashland Chemical
Podolski	Kenneth	St. Clair Shores Fire Department
Ruhana	George	Stoney Creek Metro-Park
Salyers	David	Warren Fire Department
Seehase	Charles	LEPC Vice Chairman
Shoemaker	Cole	Macomb County Environmental Health
Shotwell	Floyd	Bruce-Romeo Fire Department
Staelgraeve	Ken	Harrison Township Fire Department
Stanek	Roger	Ashland Chemical
Stevens	Hannah	MSU Extension Office
Swanson	Leigh	DuPont
Trabbic-Pointer	Denise	DuPont
Vettraino	Richard	Elite Trauma

Executive Summary

Recent disasters and accidents, regardless of scale, have focused the attention of government officials and citizens alike on the economic, human, and environmental costs of disasters. The **Macomb County Hazard Mitigation Plan** was created to protect the health, safety, and economic interests of Macomb County residents and businesses by reducing the impacts of natural and technological hazards through hazard mitigation planning, awareness, and implementation. An analysis of Macomb County was conducted using a hazard analysis format created by the Michigan State Police, Emergency Management Division. This hazard analysis format identifies 27 potential hazards. Macomb County has experienced or has the potential to experience all of the 27 hazards that the state has identified relevant to Michigan.

In Macomb County, the hazard analysis, using frequency and severity as the main criteria, identified three main hazards:

- 1) Flooding, both riverine and urban,
- 2) Hazardous materials, at fixed sites and transporting of, and
- 3) Weather-related hazards, such as wind storms, tornadoes, severe winter storms that not only cause deaths, injuries and economic losses but also attack the county's infrastructure.

Flooding

Focusing on two major initiatives can help to mitigate flooding hazards in Macomb County. The first initiative focuses on identifying flood problems in the southern and center portions of Macomb County. The problems have been identified and programs developed that elevated homes out of the flood plain or the purchasing of flood-prone property and developing that property for recreational use. Examples of existing programs can be found in St. Clair Shores, where state funds, obtained by local officials, were used to elevate homes in Clinton Township where property in the flood plain was purchased and recreational areas were developed. In Macomb Township, flood plain areas were zoned for golf courses that prevented structures from being built in the flood plain while improving the quality of life for its residents. Efforts by the County's Public Works Department should be recognized for their placement of retention and detention ponds in developing areas to reduce the effects of heavy rains in the Clinton River. The second major initiative is to identify flood plains in the northern area of the county. The County's Emergency Manager recently obtained a grant that identified floodplain areas in Ray, Armada and Lenox Townships. The present task is to work with local government officials to prevent structures from being built in the floodplain and develop that area for recreational purposes and to elevate existing homes out of flood-prone areas.

Hazardous Materials

Macomb County is one of the leading manufacturing counties in the United States. Along with that distinction comes the realization that great amounts of hazardous materials are going to be used in manufacturing processes. Also, hazardous materials must be transported to manufacturer sites. It should be noted that over 70 dangerous hazardous materials have been identified that travel through Macomb County on a daily basis. While this study was being conducted, a fire in the City of Eastpointe occurred that released dangerous cyanide vapors. The local emergency responders had to evacuate people, close down government, school facilities and businesses. A similar incident involving sulfuric acid occurred in the City of Warren with similar outcomes, but on a smaller scale. At present, the County's Local Emergency Planning Committee, under the direction of Emergency Management, is developing site plans that will assist local communities in responding to these dangerous events. Mitigation efforts should be focused on placing schools, hospitals, government facilities and other locations of public assembly away from manufacturing sites or routes of transportation. Today, in Macomb County we are still building schools and government buildings

next to hazardous areas that can turn a hazardous material incident into a disaster. Macomb County's Emergency Management Department is developing a hazard mitigation committee to work with local planning officials to emphasize the need for hazard mitigation planning.

Weather-Related Hazards

Macomb County, being located in the State of Michigan, is exposed to virtually every type of weather-related hazard. Developing well-trained local building and fire prevention inspectors who enforce the provisions of the local communities model codes can reduce the effects of weather-related hazards. Also by encouraging sound urban forestry practices that safeguard the area's infrastructure, such as electrical power and gas lines, from damage as the result of improper tree location can reduce the effects of weather-related damage. While we cannot control the weather, we can reduce the amount of damage that could occur and the recovery time needed to restore services to our citizens and businesses.

Summary

This plan serves as the foundation for hazard mitigation activities and actions within the County of Macomb. Implementation of recommendations will reduce loss of life, destruction of property, and economic losses due to natural and technological hazards. The plan provides a path toward continuous, proactive-reduction of vulnerability to hazards that result in repetitive severe social, economic and physical damage. The end goal is full integration of hazard mitigation concepts into day-to-day governmental and business functions and management practices.

This plan employs broad perspective in-depth examination of multi-hazard mitigation activities and opportunities in Macomb County. Emphasis is placed on hazards that have resulted in threats to the public health, safety and welfare, as well as the social, economic and physical fabric of the community. The plan addresses such hazards as floods, tornadoes, windstorms, winter storms, forest fires, structural fires, hazardous material incidents, and secondary technological hazards that result from natural hazard events. Each hazard was analyzed from a historical perspective, evaluated for potential risk, and considered for possible mitigative action.

Acknowledgments

This hazard analysis could not have been completed without the cooperation of the County's Planning and Economic Development, Public Health, and Public Works Departments. The information and assistance given to this project by the county's fire and police departments demonstrated again why they are considered to be one of the best organized public services in the State of Michigan and a major reason why potential disasters in Macomb County have been reduced to incidents.

Deep appreciation and gratitude must also be expressed for the staff of the Michigan State Police, Emergency Management Division, Mitigation/Recovery Section. Without their assistance and many long hours of work, the development of this mitigation plan, especially with reference to the FMA Section, would not have been completed as professionally as it is in its' final form.

Hazard Mitigation Plan

Goal

The Macomb County Hazard Mitigation Plan was created to protect the health, safety, and economic interests of residents by reducing the impacts of natural and technological hazards through hazard mitigation planning, awareness, and implementation.

Hazard mitigation is any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. It is an essential element of emergency management along with preparedness, response and recovery. This plan serves as the foundation for hazard mitigation activities within the community. Implementation of the plan's recommendations will reduce injuries, loss of life, and destruction of property due to natural and technological hazards. The plan provides a path toward continuous, proactive-reduction of vulnerability to the most frequent hazards, which result in repetitive and often severe social, economic and physical damage. The end goal is total integration of hazard mitigation activities, programs, capabilities and actions into normal, day-to-day governmental functions and management practices.

Planning Process

The Macomb County Hazard Mitigation Plan examines multi-hazard mitigation activities and opportunities. Emphasis is placed on hazards that have had significant impact on the community in the past. The planning process followed in the development of the Macomb County Hazard Mitigation Plan consisted of the following steps:

- 1) Developing a community profile for Macomb County as a whole and its individual communities.
- 2) Identification of hazards and risks.
- 3) Identification and definition of goals and objectives.
- 4) Identification of alternatives for solving problems.
- 5) Selection of filtering criteria.
- 6) Selection of alternatives and preparation of a draft plan.
- 7) Preparation of the final plan.
- 8) Implementation of the plan.
- 9) Monitoring and adjustment of the plan.

Monitoring and Adjustment of the Plan

The Macomb County Emergency Management Coordinator will monitor the plan on a regular basis. Macomb County is a dynamic, constantly changing community, so it is expected that the plan will be revised frequently. Plan evaluation and maintenance is the responsibility of the County's Assistant Emergency Management Coordinator. Proposed changes in the plan will be presented to the Local Emergency Planning Committee as needed, but not less than annually. The Assistant Emergency Management Coordinator will update the Macomb County Local Emergency Planning Committee (LEPC) as needed.

The Community Profile of Macomb County

Today's external environment for Macomb County is increasingly volatile and complex. Advancing technology, the global economy, shifting demographics, the information superhighway, and altering lifestyles are just a few of the factors that contribute to change. These factors are continually reshaping and redefining the way we live, work, think and the way we must respond to hazards in our county.

Community decision-makers in Macomb County must be able to adapt to this rapidly changing external environment. They must be aware of the hazards we face today and emerging hazards that could potentially affect their community's goals, effectiveness and survivability. The purpose of creating a community profile, for Macomb County, is to make this information readily available, so community leaders can make informed decisions.

Community profiling is a systematic approach that examines trends, changing conditions, and emerging hazard issues. It alerts decision-makers to the forces of change early enough to, assess community impact, divert or mitigate potential threats, and capitalize on opportunities. In short, *community profiling helps community leaders manage change, rather than be managed by it.* Hazards can be mitigated to prevent or reduce the effects of an incident from becoming a disaster.

This community profile of Macomb County identifies trends and emerging issues in three areas. These include history of the area, present trends and future trends.

Introduction

Named in honor of General Alexander Macomb, a highly decorated veteran of the War of 1812, Macomb County was formally organized in 1818 as the third county in the state of Michigan (after Wayne and Monroe counties). At the time of its establishment as a county, Macomb was considerably larger than it is today. Macomb County's original boundaries extended north through much of the thumb region of the state, east to Lake Huron, and west to the middle of the state. This area included all the territory that now forms the counties of St. Clair, Oakland, Livingston, Genesee, Lapeer, large portions of Shiawassee, Ingham, Sanilac and Tuscola, as well as, smaller portions of Huron and Saginaw counties. In 1819 and 1820, large portions of the County were removed to form the counties of Oakland, Lapeer, Genesee and St. Clair.

History

The first Europeans had arrived in the Macomb County area during the 17th century. They included French fur trappers who recognized the richness of the marshes and sought new opportunities for trade. The first organized immigrant settlement in the county was established in 1784 by a group of missionaries known as the Moravians. They settled along the banks of the Clinton River, then known as the Huron River, but were forced to leave four years later by the Chippewa Indians.

In 1796, a man named Christian Clemens established a new settlement, located on the Clinton River a few miles downstream. Known as Mount Clemens, the settlement would eventually become the Macomb County seat. In the 1800's, settlers moved into the interior of the county, carving out farms from the hardwood forests.

During the 1870's, mineral baths brought international fame to Mount Clemens. Many believed the waters had healing powers. Although the stream still runs beneath the city, interest in the spas died out in the early 20th century.

Between 1920 and 1930, Macomb County doubled in population, rising from 38,103 to 77,146 persons. Two significant developments spurred this growth, the establishment of Selfridge Field in 1917 and the beginning of the urbanization movement northward from the City of Detroit. During the 1940's and 1950's, the movement from the central city to the suburbs increased. The largest growth occurred between 1950 and 1970, when over 440,000 people were added to the county's population.

Today, Macomb County encompasses 482 square miles and ranks third in population in the State, with a 2000 census total of 788,149 persons. The county is recognized as a leader in business and industry, and designated as a "Community of Economic Excellence" by the State of Michigan. Despite its large population and urban characteristics, approximately 55 percent of the county's land area is vacant or in agricultural use.

Present Trends

Macomb County is situated within 500 miles of half of the population of the United States and is a major part of the Greater Detroit World Technology Center in southeastern Michigan. Macomb County is 482 square miles in area, about half of which is fully developed. Many choice areas await development for homes, businesses and industry. Much of that land is located on or near Lake St. Clair, a critical link in the Great Lakes system.

General Profile of Macomb County

Macomb County is regionally linked to the Greater Detroit Metropolitan Area. It is ranked 6th among the largest 120 metropolitan areas of the United States (U.S.) by the Office of Justice Programs (OJP). Integral to the Greater Detroit Metropolitan Area, transportation, industry, commerce, recreation, infrastructure, communications, finance and government facilities exist which may be chosen as targets for domestic and international terrorism. Macomb County is the third largest county in Michigan in population and state equalized value, behind the contiguous counties of Oakland and Wayne. The largest city in Macomb County is Warren, the third most populous city in Michigan with a strong industrial base.

Macomb County has economic ties to Chicago, Cleveland, Pittsburgh, New York, and other metropolitan areas of the nation. It shares the 74 miles of international border with Ontario, Canada, accessed with border crossings by:

- Bridge from Port Huron to Sarnia, Ont.
- Underwater railroad tunnel from Port Huron to Sarnia, Ont.
- Bridge from Detroit to Windsor, Ont.
- Underwater tunnel from Detroit to Windsor, Ont.
- Ferry service (truck) from Detroit to Windsor, Ont.
- Ferry service from Marine City to Sombra, Ont.
- Ferry service from Algonac to Walpole Island, Ont.
- Underwater pipelines from Marysville and St. Clair to Sarnia, Ont.
- Overhead electrical transmission lines from St. Clair to Sarnia, Ontario and
- Numerous public and private marinas and privately owned access points.

The interstate highway system, Detroit Metropolitan Airport, Detroit City Airport, the Port of Detroit and heavy rail systems transiting through Macomb County, provide easy access to county destinations from anywhere in the world.

Fifty percent of the land area in Macomb County is devoted to industrial, commercial and residential use. Population growth, supported through immigration, continues to expand. Current estimates for 2002 show a county population surpassing 800,000. Similar projections by the Southeast Michigan Council of Government predict a census of 832,000 by the year 2010.

Macomb County is heavily industrialized with 116 industrial facilities reporting the manufacture, storage, or use of Extremely Hazardous Substances (EHS), as defined by

Section 302 of the Superfund Amendments and Reauthorization Act (SARA). Led by major corporations such as Ford Motor, DaimlerChrysler AG, General Motors, Dupont Automotive, Lear Ziegler, TRW, the Becker Group, and General Dynamics, Macomb County is ultimately tied to the national and international community, both industrially and economically. Also, Macomb County is a major engineering and design center for U.S. industry. Annually, corporations in Macomb County receive millions of dollars in U.S. Department of Defense (DOD) contracts. Presently, the U.S. Government employs over 6,494 workers in Macomb County. Additionally, long term defense contracts serviced by regional military contractors include military hardware vehicles, munitions and components to the U.S. military and foreign governments, including Turkey, Egypt and Saudi Arabia.

Infrastructure

Existing generalized sanitary sewer service in Macomb County is provided by the Detroit Metropolitan Water Department, which serves approximately 60% of Macomb County. The City of Warren and the City of Mount Clemens operate their own treatment plants. The remaining portions of Macomb County are served by individual septic tank systems. This disposal system shares an international water system, Lake St. Clair and the Detroit River, as the disposal site for treated effluent. This treated effluent also affects the downstream states of Ohio, Pennsylvania, and New York.

Macomb County residents receive water from one of eight public agencies or from private wells. The major supplier is the Detroit Metropolitan Water Department serving 95% of the demand for public water in Macomb County. This utility draws 70% of its water supply from an international body of water, Lake St. Clair that is downstream of the St. Clair River, Lake Huron, and Lake Superior. Other communities draw water from public wells, or Lake St. Clair. In the less urban areas and northern Macomb County, residents use private wells.

Macomb County has electrical power supplied to 100% of the populace, which is serviced by the Detroit Edison Company. Major transmission lines from generating plants serving Southeastern Michigan crisscross through Macomb County to Ontario, Canada. Substantial numbers of sub-transmission lines, power stations and substations exist throughout Macomb County, necessary to serve county consumers and provide electrical service to the Southeast region of Michigan.

Military facilities include the U.S. Army Tank Automotive and Armaments Command (TACOM) and Selfridge Air National Guard Base. These military facilities serve the U.S. military throughout the nation and support U.S. protection of military forces overseas. The 127th Fighter Group is stationed at Selfridge and the TACOM mission supports the U.S. Army in procurement, design and parts maintenance of armored and wheeled vehicles.

Macomb County is included in the Southeast Michigan U.S. Coast Guard area contingency plan as an area of concern. Complex systems are in place supporting transportation, storage, and mining of natural gas and oil products. Utilities that serve Macomb County with natural gas are Consumers Power Company, Southeastern Michigan Gas Company and the Michigan Consolidated Gas Company. These utilities service 100% of the residential, commercial, industrial, and governmental facilities in Macomb County, and to communities throughout Michigan and neighboring states. Michigan Consolidated Gas Company and Southeastern Michigan Gas Company own and operate large gas storage fields in northern Macomb County, in addition to multiple transmission and service

lines associated with this industry, serving natural gas to consumers regionally and in outstate Michigan. Pipelines serving oil and gas suppliers and producers in the U.S. and Canada are maintained by Sun Oil, Shell Oil, Michigan Consolidated Gas and American Natural Resources. These pipelines are present throughout Macomb County as major transmission routes for oil, natural gas and gasoline.

A network of the Interstate Highway System along with major U.S. and State of Michigan highways traverses Macomb County. Continuity for the movement of people, goods and services are linked to Interstate 94 serving Southern Michigan, Indiana and Chicago. Interstate 696 crosses the southern portion of Macomb County, linking I-94, I-75, and I-96. This thoroughfare services the midwestern U.S. region by providing connection between the counties and the industrialized corridors of M-53 and M-97 and the commercial areas of M-102 (southern) and M-59 (middle). I-69, located north of Macomb County, connects Canada to the midwest United States and is connected to highways serving Macomb County.

Buses operated by the Suburban Mobility Authority for Regional Transportation (SMART) and the Detroit Department of Transportation provide public transportation. Bus routes link Macomb, Wayne and Oakland Counties and the City of Detroit.

General aviation in Macomb County is centered upon three privately owned, public use airports. The most well equipped airport in Macomb County is Selfridge Air National Guard Base, a military facility in Harrison Township.

Two heavy rail companies, CSX and Canadian Northern (CN) maintain 70 miles of main line rail tracks in Macomb County. Servicing international and national shippers, the companies transport heavy volumes of chemicals, vehicles, industrial supplies and manufactured products. Canadian Northern serves as the major shipper of chemicals (over 300 hazardous chemicals identified) to the U.S. from Canada, while CSX provides service to large defense contractors, including shipments of armored vehicles, military components and munitions.

There are (8) general care hospitals, (28) nursing and convalescent homes, (4) special medical care facilities and (12) free standing health clinics located in Macomb County. Three (3) of the general care facilities are certified as Trauma Centers by the Academy of Emergency Care Physicians, including Mount Clemens General Hospital which is also certified as an open heart surgical facility. Five (5) of the eight (8) facilities have full emergency room operations, receiving patients from the region. Additional facilities include general care hospitals in Oakland, Wayne and St. Clair counties, which receive and treat Macomb County residents, as well.

Communications are consistent with commercial services provided by AT&T, Ameritech, MCI and Sprint. Cellular telephone systems provide adequate coverage to the entire region. Emergency communications include an enhanced 911 system provided by Ameritech. Central control systems and multiple central communications facilities serving commercial telephone service exist in Macomb County, linking regional, national and international networks.

Land mobile communications, including public safety services use conventional radio spectrum assigned by the Federal Communications Commission. A major problem exists, as there are no inter-operability frequencies licensed between Macomb County public safety resources, either agency to agency, or jurisdiction to jurisdiction.

There are over 5,000 acres of public parks and 1,000 acres of local recreation land in Macomb County. Macomb County ranks first in the State of Michigan in the number of marina facilities and small watercraft registered to private owners. Watercraft from neighboring states as well as international vessels utilize these facilities. Recreational activity utilizes the natural resources of the area, with emphasis on sports, fishing, boating and swimming supported by the extensive water resources. The Michigan Department of Natural Resources (DNR) issues 200,000 sport hunting licenses to county residents. The northern two-thirds of Macomb County is open to hunters. Numerous gun manufacturers and suppliers are available to support recreational hunting activities.

Professional and collegiate sports activities are regional and include the National Basketball Association, National Football League, American Baseball League, National Hockey League and International Hockey League franchises, college, and university sport programs, including stadiums and arenas for each of these sports. Attendance at the sporting events can exceed over 100,000 people.

Demographics

Macomb County ranks third in population out of Michigan's 83 counties. Nationally, Macomb ranks 47th out of 3,100 counties.

Macomb County is ranked third in state equalized valuation of all counties in Michigan and in 2002 received the top rating from Moody's Investment Service.

Manufacturing is the county's leading industry, employing over a third of its 400,000 workforce. Innovative training and retraining programs offered at Macomb Community College and in the plants keep this strong, industrial labor force on top of the new technology.

Job Growth in Macomb County

<u>Occupation</u>	<u>1st Quarter 1991</u>	<u>1st Quarter 1998</u>	<u>% Change</u>
1. Manufacturing	99,700	111,181	11.5
2. Retail	55,600	58,111	4.5
3. Services	50,900	74,389	46.1
4. Wholesale	10,700	14,409	34.7
5. Construction	9,600	15,626	62.8
6. Finance	7,200	9,531	32.4
7. Transportation	5,400	6,758	25.1
Total	239,100	290,007	21.3

Industry Trends

Average weekly wages in Macomb County reached \$732 in 1998, a 38% increase since 1991. The largest wages were in the auto industry where the average wage was \$1,525. Macomb has enjoyed 51,000 new jobs since 1991, a 21 percent increase in the work force. The business services companies experienced the biggest gains in jobs. Of the 3,042 counties in the nation, Macomb ranked third in job growth in 1998.

Key indicators remained strong in Macomb in 1998, with nearly 8,000 homes sold at an average price of \$134,890, nearly 5,000 building permits issued and automobile sales rising to 78,000.

Commercial and industrial construction reached its highest level as facilities, totaling 19 million square feet, were built in 1998 or are currently being completed. Forty-three major building projects launched in 1998 will create or maintain 7,500 jobs.

Macomb County also experienced a surge in hospital construction and expansion. Five major hospitals in the county have spent a total of \$100 million on expansions and new facilities in the past

two years. They plan to spend tens of millions more as they compete for the county's growing health care market.

Educational Trends

The county's school enrollment from 1994-98 rose 7.25 percent, ranking Macomb County number one in Michigan. Macomb Community College is the sixth largest granter of associate's degrees in the nation and ranks first in 1-year certificates granted annually.

Regarded as the first such institution, the Macomb Community College University Center opened in 1991 in Clinton Township, with the mission of increasing the proportion of county residents who have bachelor's degrees. The center enrolls more than 2,000 students and is presently building a new engineering technology center.

Macomb County's Largest Employers, Ranked by Full-time Employees in January 1999:

Rank	Name	Employees
1	General Motors Corp.	21,360
2	DaimlerChrysler AG	14,300
3	Ford Motor Co.	11,000
4	US Government	6,494
5	General Dynamics Land Systems	4,191
6	St. Joseph Health System	3,024
7	Kmart Corp.	2,439
8	St. John Health System	2,439
9	Mercy Health Services Inc.	1,952
10	EDS Corp.	1,700
11	Becker Group Inc.	1,563
12	CDI Transportation Group	1,455
13	Aetna Industries Inc.	1,379
14	Macomb Community College	1,169
15	State of Michigan	1,115
16	Ameritech-Michigan	1,000
17	Automotive Plastic Technologies	926
18	Arbor Drugs	881
19	The Kroger Co. of Michigan	777
20	Dupont Automotive	750

Managerial and professional fields are also well represented in Macomb, comprising 20 percent of the total job market. Contributing a wealth of experience and knowledge, Macomb's professional community provides strong support for business and industry and sets standards followed by the rest of the country.

Future Trends

Macomb County has the room and reputation for accommodating development. New and ongoing construction of full-service industrial parks, manufacturing plants, office centers, research and development facilities, retail centers and residential construction continue to expand the existing economic investment.

Those who have built their facilities in Macomb have found that industrial development is encouraged and supported, with 4,000 acres designated specifically for that purpose. The clustering of these sites along one of Macomb's industrial corridors allows firms to be close to both their suppliers and their customers.

Macomb has 61 industrial parks, with state of the art appeal for new businesses. Site considerations already addressed to ensure timely start up include internal roads, complete utility service, access to major transportation arteries, security and safety. These industrial parks also present challenges to public safety officials as they increase exposure to hazardous chemicals and the possibilities for chemical accidents. Careful zoning and enforcement of building and fire prevention codes will mitigate these hazards.

In a study undertaken by the Industrial Technology Institute of the University of Michigan, Macomb County and its neighbors, Oakland and Wayne, were named as strongholds for high growth, technology based firms. Macomb County was cited in the same study for its impressive "island of automation."

Although the county has become a popular choice for development with construction costs averaging more than \$420 million per year, room to build is still plentiful with 55 percent of Macomb County's land area still undeveloped. This provides the Office of Emergency Management the opportunity to work with the county's northern community leaders to mitigate hazards.

Macomb County

Macomb County is the ninth smallest of Michigan's 83 counties (with 482 square miles), yet it ranks third in both population and State Equalized Value. Among the county's 27 municipalities are included three of the ten largest communities in Michigan; Warren (3rd), Sterling Heights (6th), and Clinton Township (10th). Manufacturing is Macomb County's leading industry, employing roughly one-third of the workforce. Major manufacturers alone have invested over \$2 billion in the county since 1990. Macomb County is their "location of choice" because they recognize that the business environment, quality infrastructure, and productive workforce make for a smart investment that will pay handsome dividends well into the future.

Macomb County - General Data

DISTANCE	MILES	KM
Chicago	280	450
Detroit	10	16
Indianapolis	290	466
Lansing	90	144
Toronto	250	402

YEAR	POPULATION
1970	625,309
1980	694,600
1990	717,400
2000	788,149

WORKFORCE		
LABOR	LMA	COUNTY
Total Labor Force (1997)	2,283,225	427,725
Employed	2,147,275	412,675
Unemployed	87,050	15,050
Unemployment Rate	4.1%	3.5%

LMA=Labor Market Area Source: Michigan Employment Service Agency

CHARACTERISTICS OF LABOR FORCE	COUNTY
Workers 16 and Older (1990)	349,937
Percentage who work out of county	41.1
Percentage who work at home	1.3

EDUCATIONAL ATTAINMENT

Persons 25 years of age or older	472,323
Percentage with high school diploma	76.9
Percentage with bachelor's degree	13.5

Source: U.S. Bureau of the Census, Census of Population and Housing

TRANSPORTATION

ACCESS TO MARKETS

Main Highways	I-94, I-696, I-75, M-19, M-53, M-28, M-3, M-102, M-97, M-59
Bus Lines	Greyhound
Truck Lines	46
Rail Lines	Conrail, Grand Trunk Western; Chesapeake & Ohio
Ports	Marine City (20 mi-St. Clair River)
Airports	Romeo Airport, Detroit Metro (Wayne Co.), Berz-Macomb Airport, Macomb Airport
Airlines	Southwest, American, British

Source: MI State Transportation Commission, 1995

Macomb County - Economy

PERSONAL INCOME (In Thousands of Dollars)

<u>Components by Type</u>	1995	1996	1997	1998
Personal income	19,605,379	20,070,910	21,488,431	22,254,685
Nonfarm personal income	19,594,186	20,063,401	21,479,370	22,245,246
Farm income	11,193	7,509	9,061	9,439
Population (number of persons)	765,957	778,699	783,031	786,866
Per capita personal income (dollars)	25,596	25,775	27,443	28,283

Components by Industry

Farm Earnings	11,193	7,509	9,061	9,439
Non-Farm Earnings	14,232,809	14,376,976	15,199,161	15,769,899
Private Earnings	12,671,961	12,810,660	13,543,292	14,113,070
Ag. serv., forestry, fishing, and other	55,150	67,480	76,306	76,624
Mining	3,211	2,685	2,862	2,725
Construction	703,573	793,289	917,517	1,039,862
Manufacturing	6,847,206	6,631,787	7,007,654	7,152,468
Durable goods	6,055,579	5,800,397	6,103,231	6,191,715
Transportation and public utilities	282,719	277,642	290,834	326,134
Wholesale trade	718,116	736,952	805,070	852,285
Retail trade	1,113,636	1,138,432	1,146,668	1,208,931
Finance, insurance, and real estate	354,903	413,824	446,535	493,667
Services	2,593,447	2,748,569	2,849,846	2,960,374
Government and government enterprises	1,560,848	1,566,316	1,655,869	1,656,829
Federal, civilian	426,748	435,236	471,896	473,897
Military	44,143	44,498	42,409	38,674
State and local	1,089,957	1,086,582	1,141,564	1,144,258

EMPLOYMENT BY INDUSTRY (Number of Jobs)

<u>Components by Type</u>	1995	1996	1997	1998
Total Employment	391,961	397,476	401,367	404,988
Wage and Salary Employment	345,621	349,760	352,631	354,908
Proprietor's employment	46,340	47,716	48,736	50,080
Farm Employment	1,115	1,035	1,015	973

Non-Farm Employment	390,846	396,441	400,352	404,015
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Components by Industry

Private	354,502	360,425	364,353	367,896
Ag. serv., forestry, fishing, and other	3,182	3,433	3,561	3,435
Mining	311	278	303	295
Construction	20,401	21,956	23,752	24,898
Manufacturing	115,333	113,316	114,425	114,236
Transportation and public utilities	8,035	7,932	7,930	8,464
Wholesale trade	15,356	15,530	16,125	16,484
Retail trade	71,346	71,113	70,047	70,503
Finance, insurance, and real estate	19,532	20,312	20,914	21,842
Services	101,006	106,555	107,296	107,739
Government and government enterprises	36,344	36,016	35,999	36,119
Federal, civilian	7,643	7,325	7,123	6,797
Military	2,280	2,164	2,056	1,889
State and local	26,421	26,527	26,820	27,433

Source: Bureau of Economic Analysis, U.S. Department of Commerce - Issued June 2000

EARNING LEVELS/LABOR RATES AVERAGE HOURLY RATES

CLASSIFICATION	MINIMUM*	MAXIMUM
Applications Software Specialist	7.75	15.00
Assembler – Light	4.75	8.50
Drafter (CAD)	7.00	14.75
Electrician – Industrial	8.00	15.50
Electronic Technician	7.75	13.50
Forklift Operator	5.25	10.50
General Office Clerk	5.00	9.00
General Laborer	4.50	8.50
Injection Molding Machinist	5.25	9.50
Machine Operator	5.50	10.50
Machinist	6.75	12.50
Mechanical Engineer	14.25	24.50
Production Manager/Supervisor	8.00	15.25
Quality Control Technician	8.25	15.25
Sales - Non-Technical	7.00	12.50
Secretary	5.25	12.00
Tool and Die Maker	8.25	16.50
Word Processor/Typist	5.00	11.50

Source: 1996 Survey of the Michigan Employment Security Commission

*This survey was done in 1996, before the hourly minimum wage was increased to \$5.15 in September 1997.

PRINCIPLE EMPLOYERS

MANUFACTURING EMPLOYERS

SIC	FIRM	LOCATION	EMPLOYEES	PRODUCT
3711	General Motors Corp	Warren	4,000	Auto design eng & assembly
3714	Ford Motor Co/Axle Plt	Sterling Hts	4,000	Rear axle assemblies
3713	Chrysler Corp	Warren	3,700	Truck assembling
3465	Chrysler Corp/Sterling Stamp	Sterling Hts	3,540	Automotive stampings
3711	Chrysler Corp/Assmblly	Sterling Hts	3,030	Automobile assembly
3714	Ford Motor Co	Shelby Township	3,000	Interior trim components

3465	Chrysler Corp	Warren	2,653	Auto stampings & subassem
3714	General Motors Corp	Warren	2,500	Auto trans, wheels, control arms
2396	Ford Motor Co/Trim Plt	Chesterfield	2,090	Cut & sew automotive interior
3465	Aetna Industries Inc	Center Line	1,400	Metal automotive stamping
3465	Aetna Industries Inc	Center Line	1,400	Automotive stampings
3465	Aetna Industries Inc	Warren	1,400	Automotive metal stampings
3714	Ford Motor Co	Sterling Hts	1,300	Front suspension comp & trans
3714	Ford Motor Co/Engine Plt	Romeo	1,200	Automobile engines
2711	Detroit Newspapers	Sterling Hts	1,200	Newspaper pub & offset printing
3545	Lamb Technicon	Warren	850	Machine tools, spec weld systs
2399	T R W/Vehicle Safety Systems	Washington	850	Seat belts & air bags
3714	T R W Inc	Sterling Hts	807	Automobile parts
3452	M N P Corp	Utica	800	Bolts, screws, washers
3795	General Dynamics Inc	Sterling Hts	800	Army tanks

Source: Harris Publishing Company, 1998 Industrial Directory

OTHER MAJOR EMPLOYERS

SIC	FIRM	LOCATION	EMPLOYEES	PRODUCT
8062	St. John Health System	Warren	2,249	Health care
8062	Mercy Health Services	Warren	1,952	Health care
7371	EDI Corporation	Warren	1,700	Global Information SVCS
8062	Mount Clemens General Hospital	Mount Clemens	1,373	Health Care
8222	Macomb Community College	Warren	1,169	Higher Education
4813	Ameritech Corporation	Mount Clemens	1,000	Telecommunications

Source: Local County Economic Development Contact

INDUSTRIAL AND COMMERCIAL SERVICES

TYPES OF SERVICES ESTABLISHMENTS

Retail Trade	4,160
General building contractors	182
Commercial printing	90
Trucking and courier services, except air	219
Wholesale trade - durable goods	861
Advertising	21
Computer and data processing services	120
Legal services	332
Engineering and architectural services	273
Accounting, auditing, and bookkeeping	198
Research and testing services	28
Management and public relations	121

Source: U.S. Department of Commerce and Bureau of the Census, County Business Patterns Issued November 1997

FINANCIAL INSTITUTIONS

BANK OR SAVINGS AND LOANS	BRANCHES IN COUNTY	TOTAL DEPOSITS (\$000)
Comerica Incorporated	38	2,330,719
Standard Federal Bank	19	1,319,532
Huntington Bancshares Inc.	30	997,965
NBD Bancorp, Inc.	13	989,479
First of America Bank Corp.	22	831,080
Michigan National Corp.	15	489,390
First Federal of Michigan	12	487,106
First National Bank Corp.	16	475,876
First State Financial Corp.	8	319,885

First Nationwide Bank, an FSB	4	148,749
TCF Bank Michigan, FSB	6	90,724
Detroit Savings Bank, FSB	2	85,206
Citizens State Bancorp, Inc.	4	57,627
Sterling Bank and Trust, FSB	3	37,289
D&N Bank, an FSB	1	33,012
Macomb Federal Savings Bank	1	32,415
Peoples State Bank	1	4,577

Source: Sheshunoff Branch source, 1994

CERTIFIED INDUSTRIAL PARKS

COMMUNITY	PARK NAME	TOTAL ACRES	AVAILABLE
Macomb Twp	Erb Industrial Park	68	40
Sterling Heights	Bart Industrial Subdivision	80	0

Source: Michigan Jobs Commission, 1998

NEWSPAPERS

NAME	DISTRIBUTION
Macomb Daily	Daily
Armada Times	Weekly
Macomb Plus	Weekly
Clinton Advisor	Weekly
Clinton Harrison Twp Advisor	Weekly
Chesterfield Review	Weekly
The Voice (New Baltimore)	Weekly
The Review (Richmond)	Weekly
Washington Advisor	Weekly
Romeo Observer	Weekly
Washington Advisor	Weekly
Sterling Heights Source	Weekly
Utica Shelby Twp Source	Weekly
Warren Advisor	Weekly
Warren Weekly	Weekly

Source: Michigan Newspaper Directory, 1997

Macomb County - Municipal Services

UTILITIES

COMMUNITY	ELECTRIC	/	GAS
(Armada (Village of), Armada Twp, Bruce, Chesterfield, Lenox, New Haven (Village of), Ray, Richmond, Richmond Twp.)	Detroit Edison		Southeast Michigan Gas Co.

(Center Line, Clinton Twp, Eastpointe, Fraser, Harrison Twp, Mount Clemens, Roseville, St. Clair Shores, Shelby Twp, Utica, Warren)	Detroit Edison	Consumers Power
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TELECOMMUNICATIONS

Local Phone Companies	Ameritech
Long Distance Companies	AT&T, MCI, Sprint, and others

LICENSED LANDFILLS

COMMUNITY	OWNER/MANAGER
Lenox	Pine Tree Acres, Inc.

Roseville South Macomb Disp. Authority
 Warren City of Warren
 Source: MDEQ Waste Management Division, 1998

PROPERTY TAX

AGRICULTURAL	COMMERCIAL	INDUSTRIAL	RESIDENTIAL	OTHER
0.52%	15.40%	17.14%	66.83%	0.10%

Source: MI Department of Treasury, 1997

GOVERNMENT

COMMUNITY	PHONE NUMBER	COMMUNITY	PHONE NUMBER
Armada (Village of)	(586) 784-9151	Armada Twp	(586) 784-5200
Bruce Twp	(586) 752-4585	Center Line (City of)	(586) 757-6800
Chesterfield Chrtr Twp	(586) 949-0400	Clinton Charter Twp	(586) 286-8000
Eastpointe (City of)	(586) 445-5026	Fraser (City of)	(586) 293-3102
Harrison Charter Twp	(586) 466-1406	Lake Twp	(313) 881-6565
Lenox Twp	(586) 727-2085	Macomb Twp	(586) 266-0621
Memphis (City of)	(586) 392-2385	Mt Clemens (City of)	(586) 469-6803
New Baltimore (City of)	(586) 725-2151	New Haven (Village of)	(586) 749-5301
Ray Twp	(586) 749-5171	Richmond (City of)	(586) 727-7571
Richmond Twp	(586) 727-7134	Romeo (Village of)	(586) 752-3565
Roseville (City of)	(586) 445-5410	Shelby Charter Twp	(586) 731-5100
St. Clair Shores (City of)	(586) 445-5200	Sterling Heights (City of)	(586) 977-6123
Utica (City of)	(586) 739-1600	Warren (City of)	(586) 574-4620
Washington Twp	(586) 786-0010		

ECONOMIC DEVELOPMENT CONTACT

Contact: Mr. Stephen N. Cassin
 Macomb County Planning and Economic Development
 1 South Main, Seventh Floor
 Mt. Clemens, MI 48043
 Phone: (586) 469-5285; Fax: (586) 469-6787

Macomb County - Quality of Life

EDUCATIONAL FACILITIES

PUBLIC SCHOOL DISTRICT INFORMATION

COMMUNITY	SCHOOL DISTRICT	STUDENTS	INSTRUCTORS	HIGH SCHOOLS
Armada	Armada Area Schools	1,650	92	1
Center Line	Center Line Public Sch	2,250	165	1
Clinton Twp	Clintondale Comm Sch	3,837	169	1
Clinton Twp	Chippewa Valley Schs	9,837	454	2
Eastpointe	East Detroit Pub Schs	6,670	304	1
Fraser	Fraser Public Schools	4,671	271	1
Harrison Twp	L'Anse Creuse Schs	8,432	460	2
Memphis	Memphis Comm Schs	950	55	1
Mt Clemens	Mt Clemens Comm Sch	3,300	185	1
New Baltimore	Anchor Bay Schools	4,310	232	1
New Haven	New Haven Com Schs	1,011	58	1
Richmond	Richmond Com Schs	1,800	92	1
Rochester	Rochester Com Schs	11,903	713	2
Romeo	Romeo Com Schs	4,480	240	2
Roseville	Roseville Com Schs	6,311	333	1
Shelby Twp	Utica Comm Schools	23,091	1,186	4
St. Clair Shores/Lake Shore Pub Schs		3,046	172	1

St. Clair Shores/South Lake Schools	2,251	123	1
St. Clair Shores/Lakeview Public Schs	2,853	156	1
Warren Van Dyke Pub Schs	4,700	220	1
Warren Fitzgerald Pub Schs	2,891	158	1
Warren Warren Consolidated	13,879	822	3
Warren Warren Woods Pub S	2,700	150	1

Source: MI Department of Education, 1997

TWO YEAR COLLEGES AND TECHNICAL SCHOOLS

NAME	LOCATION	ENROLLMENT
Macomb Community College	Warren	27,149

FOUR YEAR COLLEGES AND UNIVERSITIES

NAME	LOCATION	ENROLLMENT
Detroit College of Business	Warren	1,400
Baker College of Mount Clemens	Clinton Twp	470

Source: MI Department of Education, 1996

MEDICAL FACILITIES

TYPE OF FACILITY	# IN COUNTY	# OF BEDS
Hospitals	7	1,368

Source: MI Department of Consumer and Industry Services, 1998

HOUSING

OWNER OCCUPIED	MEDIAN HOME VALUE	RENTER OCCUPIED	MEDIAN RENT
204,609	\$76,800	60,382	\$493

Source: U.S. Bureau of the Census, 1990

CLIMATE

MONTH	AVG. MIN TEMP	AVG. MAX TEMP.
January	17F./-8C	30F./-1C.
July	62F./17C.	82F./28C.
PRECIPITATION	RAINFALL	SNOWFALL
Average Annual	28in./71cm.	34in./86cm.
GROWING SEASON	DAYS ABOVE 90F/32C	DAYS BELOW 0F/-18C
174 days	8	5

Source: NOAA Climate Summary, 1995

RECREATION

COUNTY HIGHLIGHTS

29 public and private golf courses; premier boating capital boasting more than 40,000 registered pleasure crafts and nearly 100 public and private marinas with slips accommodating over 9,000 boats; 31 miles of shoreline on Lake St. Clair with 430 square miles of open water; over 10,000 acres of recreational land including three Huron-Clinton Metroparks; proximity to urban and rural lifestyles.

Mobile Home Parks

PARKNAME	ADDRESS	CITY	SITES00
Chateau Estates Macomb I	45301 Chateau Thierry Blvd	Macomb Twp	1425
Chateau Estates Clinton	38000 Lechateau Blvd	Clinton Twp	1000
Rudgate Manor Mobile Home Park	5150 Rudgate Blvd	Sterling Heights	931
Carriage Way	29800 Guilford Circle	Chesterfield Twp	798
Sterling Estates	43475 Le Grand	Sterling Heights	760
Camelot Villa Macomb Park	17111 Hall Rd	Macomb Twp	712
Rudgate East Mobile Home Park	11111 26 Mile Rd	Washington Twp	708
Rudgate Clinton Mobile Home Park	20475 Foster Dr	Clinton Twp	667
Shelby Forest	50030 Schoenherr Rd	Shelby Twp	664
Shelby West Mobile Home Park	12277 Conservation Trail	Shelby Twp	644
Rudgate Silver Springs	43600 Park Drive West	Clinton Twp	547
Chateau at Springbrook	71400 Van Dyke Rd	Bruce Twp	403
Riverbrook Estates	58089 Gratiot Ave	New Haven	390
St. Clair Estates(Part) - Clinton Twp	23680 Sandpiper Dr	Clinton Twp	354
Chateau Estates Chesterfield	49900 Fairchild Rd	Chesterfield Twp	345
Quail Run Community	33099 Willow Lane	Lenox Twp	340
Dequindre Estates Mobile Park	48790 Dequindre Rd	Shelby Twp	303
Chateau Estates Macomb II	45301 Chateau Thierry Blvd	Macomb Twp	301
Willow Point	46400 Lenfesty	Harrison Twp	299
St. Clair Estates(Part) - Harrison Twp	23680 Sandpiper Dr	Harrison Twp	277
Shadylane Mobile Home Estates	2709 Capital F-5	Warren	270
Lafayette Place Estates	21206 Dequindre Rd	Warren	254
Parkway Village Mobile Home Park	43240 N. Gratiot Ave	Clinton Twp	242
Continental Mobile Village	20785 Schultes	Warren	239
Meadow Creek	33130 27 Mile Rd.	New Haven	204
Warren Mobile Home Park	3051 E. 10 Mile Rd	Warren	192
Park Lane Mobile Home Court	3193 E. Ten Mile Rd	Warren	168
Leslie's Mobile Home Village	25214 Gratiot Ave	Roseville	166
Glenn Wood Mobile Associates	2526 Morrissey Ave	Warren	147
Twin Pines Trailer Coach Park	6815 Eleven Mile Rd	Warren	140
Blue Sky Mobile Home Village	36530 Jefferson Ave	Harrison Twp	134
Clinton River Mobile Home Country Club	24430 N. River Rd	Harrison Twp	132
Motor City Trailer Park	23765 Lawrence	Warren	126
Richmond Place Estates	36401 Division	Richmond	117
Landmark Estates	21908 Dequindre Rd	Warren	110
Washington Mobile Home Park	60630 Van Dyke Rd	Washington Twp	107
Romeo Mobile Manor	400 Notre Dame Blvd	Romeo	98
Jackson Mobile Home Park	6988 Ready St	Warren	92
Eckert's Mobile Home Court	2324 Eleven Mile Rd	Warren	77
Lakeshore Village Mobile Homes	35922 E. Jefferson Ave	Harrison Twp	45
Lakeview Trailer Court	37111 Main St	New Baltimore	42
A and L Mobile Home Park	3053 E. 8 Mile Rd	Warren	26
Lakeside Trailer Park	27860 Hickler Lane	Harrison Twp	24
John's Trailer Park	34546 Jefferson Ave	Harrison Twp	

Profiles of Communities within Macomb County

Village of Armada

Located within Armada Township in north central Macomb County, the Village of Armada lies midway between the Village of Romeo to the west and the City of Richmond to the east.

Surrounded by some of the richest agricultural land in the county, the village was incorporated in 1869 as an agricultural shipping center.

For the past fifty years, the Village of Armada has experienced slow but continuous growth and has remained a service center to the surrounding agricultural area. Each year the 1,573 village residents host the Armada Fair, the second largest fair of its kind in the state.

Single-family residences, community parks and a central business district reminiscent of many small rural towns characterize the Village of Armada.

The village is connected to the urbanized portions of the County by Armada Ridge Road (Main), North Avenue (Fulton) and M-53 to the west. The Grand Trunk Western/CN North America railroad operates a line spur that connects the village to the cities of the North American rail system. This line will be removed in the future and used for recreational activities.

Armada Township

Armada Township is located in north-central Macomb County. It borders St. Clair County to the north, Thirty-Two Mile Road on the south, and Bruce and Richmond Townships to the west and east respectively.

Organized in 1832 the Township developed as an agricultural area due to fertile soils. Today, the area has retained this rural character with a 2000 population of 3,673 residents primarily residing in single-family homes on large lots. Less than ten percent of the township's land is utilized for residential dwellings while over eighty-seven percent is devoted to agriculture or remains vacant.

Romeo Plank Road and North Avenue provide north-south linkages to the southern, urbanized portions of Macomb County. Armada Ridge and Armada Center Roads carry the majority of east-west traffic. The Grand Trunk Western/CN North America railroad operates a rail line that crosses the Township from east to west linking Armada Township to the North American rail system. This line will be removed in the future and the land donated for recreational use.

Bruce Township

Located in the northwest corner of Macomb County, Bruce Township is bordered by Oakland County to the west, Lapeer County to the north, Washington Township to the south and Armada Township to the east.

Organized in 1833, Bruce Township has retained its rural, agricultural based character. Growth has been steady but slow over the past 50 years. Bruce Township's 2000 population of 6,395 residents are serviced by commercial centers in or near the neighboring Village of Romeo. Year-round recreation activities can be enjoyed at nearby Stony Creek Metropark in Washington Township and several area golf courses.

In 1990, sixty-seven percent of the land in the township was dedicated to agriculture or remained vacant. The Ford Motor Company's Proving Grounds and Test Track comprises more than six square miles in the west-central portion of the Township.

M-53 provides the main north-south link in western Macomb County connecting Bruce Township with the urbanized commercial, industrial, and residential centers to the south. Presently, large up-scale residential units are under construction in Bruce Township. Thirty Two Mile Road and Interstate 69, approximately eight miles to the north, provide east-west access. Romeo Airport, a small general aviation facility, is located to the southeast in neighboring Ray Township.

City of Center Line

Located in southwestern Macomb County and surrounded by the City of Warren, the City of Center Line is one of the smaller cities in the county in both population and land size. Center Line is a mature suburban community with a strong industrial tax base characterized by neighborhoods of single family homes. Two primary commercial areas along Van Dyke and Ten Mile Road service the city's 2000 population of 8,531 residents. The Conrail Railroad Corridor delineates the western boundary of Center Line. This rail corridor extends in a line north from Detroit into Macomb County, servicing one of the more productive industrial corridors in the United States.

Access to major transportation networks is one of Center Line's most appealing features. Van Dyke (M-53) and Mound Road facilitate north and south travel through Macomb and into Wayne County. Interstate 696 accommodates east to west travel across the region providing connections to Interstates 94 and 75.

Charter Township of Chesterfield

Located in east-central Macomb County, Chesterfield Township lies halfway between Detroit and Port Huron. Sited along the shore of Lake St. Clair, it is one of the fastest growing communities in Macomb County.

Between 1990 and 2000, Chesterfield Township grew in population by nearly forty-four percent with the greatest increases in single and multi-family neighborhoods south of Twenty Four Mile Road. Areas north of this line still retain much of their rural character, but light industry and commercial areas are developing along the Gratiot Corridor as utilities are installed.

The township's 2000 population of 37,405 residents is serviced by commercial areas along Twenty Three Mile Road, Gratiot Avenue and within the City of New Baltimore. The township park, located on Jefferson Avenue south of Twenty Three Mile and the lakeshore, offers recreation opportunities to township residents.

Gratiot Avenue, Twenty Three Mile Road and Interstate 94 form the main transportation corridors through the Township. The majority of industry in the Township is located along Gratiot Avenue (M-3), south of Twenty Three Mile Road and within industrial parks along Twenty Three Mile Road, west of I-94. This area is serviced by two interstate interchanges (Twenty Three and Twenty One Mile Roads) and the Grand Trunk Western/CN North America railroad.

Charter Township of Clinton

Clinton Township is located in central Macomb County. This community has the largest population of any township in the State of Michigan. Clinton Township can best be characterized as a community in the final phases of transition from rural to suburbanized development.

Since 1960, Clinton Township's population has grown dramatically to a 2000 population of 95,648 persons. Its residents are serviced by a number of commercial centers located throughout the township, with major centers located along Gratiot Avenue, Groesbeck, Hall (M-59) and Garfield Roads.

Clinton Township is home to the Center Campus of the Macomb Community College, one of the largest community colleges in the U.S., the University Center and the County Library. Township residents enjoy a wide range of recreation opportunities including a recently completed bicycle path. Located adjacent to Metropolitan Parkway the bike path provides a pleasant, non-motorized, link to Metro Beach Metropark in neighboring Harrison Township. The officials of Clinton Township should receive special recognition for purchasing homes and property in flood-prone areas and turning these areas into recreational facilities. Protecting flood-prone areas from development is a top

priority for community leaders. These measures have greatly reduced the effects of flooding and improved the quality of life for their citizens.

Industrial activity is found primarily on Groesbeck Highway (M-97) and in industrial parks along M-59. Clinton Township's extensive transportation network facilitates rapid north-south transit via Interstate 94, Gratiot Avenue, and Groesbeck Highway. Major east-west travel is provided by Metropolitan Parkway and Hall Road (M-59). Rail transport is available in the southeastern portion of the Township along Groesbeck Highway via Grand Trunk Western/CN North America railroad.

City of Eastpointe

The City of Eastpointe is located in southern Macomb County. Eastpointe can be described as a mature suburbanized community characterized by neighborhoods of single family homes. It had a 2000 population of 34,077 persons. Over the past decade, the population of Eastpointe has remained relatively stable, as has the number of homes in the community.

During the past ten years, the city has initiated the revitalization of commercial centers along Gratiot Avenue and Nine Mile Road, offering modern shopping facilities and a vast array of services to area residents. The community has also been pro-active in upgrading the small number of deteriorated housing units within its stable, middle class neighborhoods.

Traffic flow in Eastpointe tends to follow a north-south pattern established by the main thoroughfares of Gratiot Avenue and Kelly Road. East-west travel is facilitated by Eight, Nine and Ten Mile Roads. Interstate 94 lies on the eastern boundary of the community, providing excellent access to other parts of the region.

City of Fraser

The City of Fraser is located in south central Macomb County. Incorporated in 1957, the City of Fraser grew rapidly during the post-war boom of World War II with the largest amount of growth occurring during the decade of the 1960's. Today, Fraser consists primarily of single-family residential neighborhoods. Industrial activity is mostly concentrated in the Fraser Industrial Park, which covers much of the northeast quarter of the city.

The city's 2000 population of 15,297 residents is serviced by commercial centers located along both Utica Road and Groesbeck Highway (M-97). These north-south roads, linked with Thirteen and Fourteen Mile Roads running east-west, form the main roadways moving people and commerce through the city. Access to Interstate 94 is close by, allowing for excellent transportation connections to other parts of the region. Paralleling Groesbeck Highway to the west is the Grand Trunk Western/CN North America railroad. This rail line serves a number of industries that lie within the Groesbeck Highway industrial corridor.

Charter Township of Harrison

Harrison Township is located in southeast Macomb County along the shores of Lake St. Clair. Harrison Township is home to Selfridge Air National Guard Base that comprises much of the northern one third of the Township. The Clinton River flows through the heart of the Township and discharges its waters into Lake St. Clair.

The township's 2000 population of 24,461 enjoy a host of water related recreation opportunities. Metropolitan Beach, one of three regional Metroparks within the County, offers residents year round recreation activities. A recently completed bike path located adjacent to Metropolitan Parkway provides township residents with a pleasant, non-motorized, link to Metro Beach Metropark.

Interstate 94 provides swift north-south travel along the western edge of the community with four interchanges servicing the township. This high-speed route linked with the east-west transportation corridor formed by Metropolitan Parkway, makes Harrison Township one of the most accessible locations in Macomb County. An area of expanding industrial activity adjoins I-94 north of the Clinton River, providing both employment and a strong tax base. Selfridge ANG Base is located within the township's borders and contributes to Harrison Township's economic stability.

Lake Township

Located in the extreme southeast corner of Macomb County, Lake Township, only 90 acres in size, is the county's smallest unit of government. The township is bounded by the City of St. Clair Shores to the west and Wayne County to the south. The shoreline of Lake St. Clair forms the northern and eastern boundaries of the township.

Lake Township is part of the incorporated community of Grosse Pointe Shores, which straddles Macomb and Wayne Counties. A series of communities comprising the Grosse Pointes are known throughout the United States as an area of wealth and influence.

Although Lake Township contains only 50 residential units, it is an area of prestigious homes. More than one half of the township consists of the Edsel and Eleanor Ford house and museum. According to the 2000 census, the 80 residents of Lake Township have the highest median family income and level of educational attainment in Macomb County.

The only major thoroughfare in the Township is Jefferson Avenue, also called Lake Shore Drive. The route from the City of Detroit through Lake Township, is one of the most scenic drives in the Detroit Metropolitan Area. Lake Township was not part of this study. They have opted to be included under the Wayne County Emergency Management Plan.

Lenox Township

Located in northeast Macomb County, just north of the rapid suburban developments, Lenox Township remains a primarily rural community.

Over the past four decades the population of Lenox Township has increased slowly to a 2000 population of 5,362 residents. Historically, agriculture has dominated the township's land use. Today, much of this land lies vacant with small portions being developed for urban uses.

Recent expansion of water and sewer service to southern Lenox Township, including the Village of New Haven, has greatly expanded opportunities for industrial and commercial development along Twenty Six Mile Road and the Gratiot Corridor.

Gratiot Avenue (M-19), 29 Mile Road, New Haven and Haven Ridge Roads are the major routes through Lenox Township. Interstate 94 traverses the southeastern corner of the township. The Grand Trunk Western/CN North American railroad parallels Gratiot Avenue to the west and links the township and the Village of New Haven with the North American railroad system.

Macomb Township

Macomb Township is located at the geographic center of Macomb County. Positioned north of Hall Road (M-59), the township is currently experiencing rapid suburbanization due to the development of residential tracts which have followed the expansion of water and sewer service.

Macomb Township grew very rapidly between 1990 and 2000. During that period, the population grew by one hundred twenty two percent to 50,478 residents. The number of occupied housing units grew at a similar rate for the same period. Presently, Macomb Township is Michigan's fastest growing community.

Historically, agriculture has dominated the landscape of the township; however, a significant amount of this land now lies vacant. Seven golf courses offer seasonal recreational opportunities to residents. Macomb Township has placed these golf courses in flood-prone areas to mitigate flood damage, while improving the quality of life for their residents. Their efforts should serve as a model for the northern developing communities in the County. The Lakeside Center and other commercial

facilities are located in neighboring communities to the southwest of the Township. Industrial activity is located along Twenty Three Mile Road and in the southeast corner of the Township.

Hall Road (M-59), Twenty Three Mile, and Twenty Six Mile Roads provide east to west routes across Macomb Township, while Romeo Plank, Hayes and North Avenue facilitate north-south movement. Regional charter flights and aviation services are available at Berz-Macomb airport in the west-central portion of the Township. Macomb Township has two large manufactured home sites, located between M-59 and Twenty One Mile Road. These sites are susceptible to damage from tornadoes and wind storms. Special efforts, by community leaders, should be made to mitigate damage to these complexes.

City of Memphis

The City of Memphis is located in the northeast corner of Macomb County on the banks of the Belle River. Positioned equally in Macomb and St. Clair Counties, Memphis is still a quiet agricultural based community.

Over the past decade, the city's population dropped a modest nine percent to a 2000 population of 807 residents in the Macomb County portion. Commercial activity is concentrated along a traditional main street - Memphis Ridge Road. Situated far north of the urbanized fringe, Memphis is very likely to retain its quiet atmosphere and small town America character.

Memphis Ridge Road (M-19) is the main north-south route that links Memphis to the City of Richmond and Gratiot Avenue to the south and I-69 to the north. Bordman Road, which forms the northern boundary of the County, bisects Memphis providing the main east-west route through the city. The City of Memphis was not part of this study. They have opted to be under the St. Clair County Emergency Management Plan.

City of Mount Clemens

The City of Mount Clemens is located in central Macomb County along the banks of the Clinton River. Incorporated in 1897, the City serves as the County Seat, the center of Macomb County government.

Since the mid-1950's, Mount Clemens has initiated many projects to enhance the city. Today, modern homes, offices and shops exist where older structures once stood. A large section of the central business district has been transformed into a shopping center, apartments, public buildings, and a motor inn. Quaint shops, a variety of restaurants and a water fountain enhance this newly revitalized downtown area.

In 2000, nearly half of the city was utilized as residential neighborhoods for its 17,312 residents. Commercial centers are found along the north-south corridor formed by Gratiot Avenue and Groesbeck Highway.

Interstate 94 to the east of the city provides excellent connections to the rest of southeast Michigan while Metropolitan Parkway to the south, Groesbeck Highway to the west, and Hall Road (M-59) to the north frame Mount Clemens with efficient links to the rest of Macomb County.

Rail transportation is provided by the Grand Trunk Western/CN North America railroad that serves a number of industrial sites on the City's northwest side. Another industrial area adjoins I-94 at North River Road.

City of New Baltimore

The City of New Baltimore is located on the north shore of Anchor Bay, a northern extension of Lake St. Clair. The city is bounded by Chesterfield Township to the west and north and by St. Clair County to the east.

Over the course of the past decade, the population of New Baltimore has increased at an impressive rate of twenty seven percent, while the number of housing units has increased at a rate of 16.5 percent. The majority of the city's 2,942 dwelling units are located less than one mile from the shoreline.

The city's 2000 population of 7,405 residents is serviced by a central business district which extends along Washington Street between M-29 and the lake shore. Many of New Baltimore's businesses service the northern end of Lake St. Clair's water related activities.

Twenty Three Mile Road (M-29) facilitates east-west travel through the city, while Interstate 94, situated less than one mile to the northwest of the city, provides access to the rest of southeastern Michigan. With over fifty percent of its land area currently vacant, the City of New Baltimore has the capacity to sustain substantial future growth.

Village of New Haven

The Village of New Haven is located in northeastern Macomb County. The Village, with a land area of 2.51 miles, comprises the largest incorporated area in Lenox Township.

Between 1990-2000, New Haven was one of the fastest growing communities north of Twenty Six Mile Road in the county. During that period, the population of the village increased thirty one percent to 3,071 residents. Likewise, the number of housing units increased by thirty-four percent for this same period. The majority of these residential units are located northwest of the village's central business district.

The Village of New Haven lies in a favorable position in regard to transportation networks. The nearby Interstate 94 provides rapid access to I-696, Detroit and Canada. Passing through the village is the Grand Trunk Western/CN North America Railroad. Its main thoroughfares, New Haven Road and Gratiot Avenue, connect the village with Mt. Clemens, New Baltimore, Richmond and Memphis.

Ray Township

Ray Township is located in north central Macomb County in an area well suited for farming. It contains the unincorporated areas of Davis, Ray Center and part of Meade. The township has grown very slowly over the past four decades. The 2000 population of 3,740 reside in just over 1,305 residences.

The vast majority of land in Ray Township is dedicated to agricultural use or lies vacant. The township is home to two public golf courses which were developed in flood-prone areas, designed to mitigate damage from flooding while improving the quality of life for its residents. A 2,000-acre Metro Park, also developed within a flood plain, consists of an interpretive farm where visitors can view agricultural life as it existed at the turn of the century.

Romeo Plank Road and North Avenue provide north and south transportation routes, while Twenty Six, Twenty Nine and Thirty Two Mile Roads facilitate east and west travel across the Township. Two miles west of the township, M-53 provides connections to the southwestern portions of the county. In addition to these surface transportation routes, two small general aviation airports serve the township. The larger facility, Romeo Airport, is located in the northwestern corner of the township, while Macomb Airport, which handles smaller aircraft, is located in the southeast area.

City of Richmond

The City of Richmond is located in northeast Macomb County. The community has exhibited moderate but steady growth as the city evolves from an agricultural-based rural community to a community with new residential and industrial areas.

In 2000, the majority of the 4,896 residents of the city lived east of Memphis Ridge road. Two commercial areas service the community. The central business district located at the intersection of Division and Memphis Ridge Roads is reminiscent of traditional small town America. The second commercial district, located at the intersection of Gratiot Avenue and M-19, offers residents modern shopping facilities and restaurants.

Gratiot Avenue that provides access to the urbanized portions of Macomb County and Memphis Ridge Road (M-19) services the City of Richmond. Division Road (32 Mile Road) facilitates east-west movement. The Grand Trunk Western/CN North America railroad operates a

main line and a secondary line through the City. These rail lines provide connections to the national rail network and eastern Canada. Plans are to remove the secondary railroad line in the future. The land is promised to be donated for recreational purposes.

Richmond Township

Richmond Township is located in the northeast corner of Macomb County and contains portions of the Village of Memphis and the City of Richmond. The township is home to a 2000 population of 3,416 persons who primarily reside in single-family homes on large lots fronting the township's main thoroughfares.

Nearly seventy percent of the land in Richmond Township is used for agricultural activities, while an additional twenty percent lies vacant. Locally grown cash crops of wheat, corn, soybeans and alfalfa comprise the majority of Macomb County's annual agricultural exports. Richmond Township is expected to experience slow growth due to its location north of the urbanizing portions of the county.

School Section and Armada Ridge Roads facilitate east and west movement through the township, while Memphis Ridge Road is the primary north and south route. The Grand Trunk Western/CN North America railroad operates a rail line connecting Richmond to the North American rail network.

Village of Romeo

The Village of Romeo is situated in northwest Macomb County and is divided by Thirty Two Mile Road, which is the boundary between Bruce and Washington Townships. Located in the heart of fertile agricultural land, the village is surrounded by fruit orchards that produce annual crops of peaches and apples. An annual Peach Festival is held in the village at the end of each summer.

Two commercial areas service the 3,721 residents of the village. The central business district along Main Street is reminiscent of many early midwestern farming towns. The second commercial area located south of the village along M-53 is characterized by modern commercial development. Golf courses and two nearby Metroparks offer year round recreational opportunities within minutes of the Village limits. Industrial activity is focused at the east end of the village.

The major transportation arteries through Romeo are the M-53 By-Pass and Van Dyke which link the village to the urbanized portions of the County to the south and Interstate 69 to the north. East-west travel is facilitated by Thirty Two Mile Road. The Grand Trunk Western/CN North America railroad operates a rail line between Pontiac and Richmond that services the Ford Motor Company's Romeo Engine Plant. This railroad line will be decommissioned in the future and turned into a recreational area.

City of Roseville

The City of Roseville, located in southeast Macomb County, is a mature suburban community of 48,129 residents. Throughout its history, Roseville has been a significant crossroads of Macomb County since many important transportation corridors intersect within its boundaries.

The population of Roseville expanded significantly during the period from 1950 to 1970 due to rapid development of residential neighborhoods, industry and commercial establishments. Roseville residents enjoy a variety of shopping, recreation and education experiences provided by a regional shopping center, modern shopping facilities, corner markets, numerous city parks and the South Campus of Macomb Community College located in neighboring Warren. Industrial activity is located primarily along Groesbeck Highway (M-97) and small industrial subdivisions in the western half of the community.

Interstate 94, Gratiot Avenue and Groesbeck Highway provide efficient north and south movement while Interstate 696, Twelve Mile Road, and Utica Road facilitate connections to western Macomb County. Paralleling Groesbeck Highway is the Grand Trunk Western/CN North America

railroad that services industries in the community with connections to the North American rail network.

City of St. Clair Shores

Located on the shore of Lake St. Clair in southeast Macomb County, the City of St. Clair Shores is home to 63,096 residents. St. Clair Shores is best described as a mature suburban community. City residents enjoy a wide range of shopping experiences along Harper Avenue that runs north and south through the center of the community. Regional shopping centers are located in the neighboring communities of Roseville and Harper Woods. Industrial activity is concentrated south of Eleven Mile Road.

During the past few decades much of the residential development along the lakeshore has undergone restoration. Many older residences have been replaced by apartments, condominium complexes and contemporary, single-family homes. Several of these developments have been built on canals that provide boat docking and direct access to Lake St. Clair.

The transportation needs of the community are met by Interstates 94 and 696 along the city's western boundary, and by modern surface thoroughfares such as Jefferson, Mack and Harper Avenues. Combined with Eight Mile Road (M-102) to the southwest of the city, this transportation network makes St. Clair Shores one of the most highly accessible communities in Macomb County.

Charter Township of Shelby

Shelby Township, located in west central Macomb County, is one of the county's fastest growing areas. It has been growing steadily since the 1960's, reaching a 2000 population of 65,159. The transition of this community from a primarily rural, agricultural area to a suburban landscape can be expected to continue well into the future.

Shelby Township's residents enjoy many options for shopping, entertainment and recreation. Lakeside Shopping Center and other large-scale commercial facilities can be found along M-59, the southern border of the Township. Industrial activity is found largely on Twenty Three Mile Road. Year round recreation activities can be enjoyed at River Bend Park or at Stony Creek Metropark in neighboring Washington Township.

Hall Road (M-59) facilitates rapid east and west connections providing access to I-94 in Macomb County and I-75 in neighboring Oakland County. The major north and south route, the M-53 freeway, connects Shelby Township with southern Macomb County and Interstate 696. Two rail lines operate within the Township. The Grand Trunk Western/CN North America Railroad cuts across the northwest corner of the Township connecting the region with the North America rail network. This line will be removed from service and set aside for recreational purposes. The Conrail line connects the area with the major industrial corridors between Van Dyke and Mound Roads south of the Township.

City of Sterling Heights

The City of Sterling Heights, located in west central Macomb County, is the second largest city in the county and the sixth largest city in the State. Exploding development from 1950 to 1970 led to the incorporation of the city in 1968. Since 1990, the population has increased five percent to a 2000 total of 124,471 residents. Equally dramatic has been the increase in residential housing units. During the period from 1980 to 2000 available housing stock increased by over twenty percent.

A well-balanced mixture of residential, commercial, recreational and industrial uses characterizes development in this community. Recreation opportunities include five golf courses, Dodge Park and Freedom Hill County Park. Lakeside Center, in the northeast corner of the city, is one of the largest and fastest growing retail areas in the State of Michigan. Industrial activity is located primarily in the corridor formed by Mound and Van Dyke (M-53) and include major manufacturing facilities and industrial parks.

Mound Road, Van Dyke, Schoenherr and M-53 provide excellent north and south connections through Sterling Heights, while Hall Road (M-59) and Metropolitan Parkway traverse the city providing connections east and west. The Conrail line services the Mound Road and Van Dyke area, one of the region's most productive industrial corridors.

City of Utica

Located in west-central Macomb County along the banks of the Clinton River, the City of Utica is one of the oldest settlements in the region.

During the period from 1960 to 1980, Utica experienced the largest influx of residents and new home construction. Today 4,577 persons reside in Utica enjoying its small town atmosphere and close proximity to major retail and employment centers. Year round recreation opportunities can be found nearby at River Bend Park and Stony Creek Metropark.

Located adjacent to Hall Road (M-59) and M-53, Utica is linked with all the region's major freeways and is readily accessible from all points within Macomb County. Conrail operates a rail line connecting Utica to the largest industrial corridor in southern Macomb County as well as the North American rail system.

City of Warren

The City of Warren is located in southwestern Macomb County. Over thirty-four square miles in area, Warren ranks by population as the largest community in the county and is the third largest city in Michigan with a 2000 population of 138,247 residents.

Incorporated in 1957, Warren's population grew rapidly, more than doubling during the period of 1950-1960. The decade of the 1960's continued this trend with the population growing one hundred and one percent. Subsequently, the city's population has continued to adjust to the decrease in family size and the impact of the "baby boomers" moving into an advanced age bracket. This is reflective of the trend that has been noted nationally.

A diverse mixture of land uses characterizes the City of Warren with single-family homes dominating the landscape. Residents enjoy commercial shopping opportunities along Van Dyke, Dequindre, Hoover and Schoenherr Roads. Recreation activities can be found at any of the numerous city parks. The South Campus of Macomb Community College offers residents continuing educational opportunities. Industrial activity is dispersed among several areas of the city, providing a strong industrial base and well paying jobs.

Mound Road and Van Dyke Highway facilitate north and south transportation through the city, while Interstate 696, Eight and Twelve-Mile Roads comprise the community's major east and west thoroughfares. Two railroads service the City of Warren's industries. Conrail provides rail service to many of the manufacturing facilities located in the highly industrial corridor between Mound and Van Dyke. The Grand Trunk Western/CN North America railroad services industries located along Groesbeck Highway (M-97) in the southeastern portion of the city.

Washington Township

Located in northwestern Macomb County, Washington Township contains the unincorporated villages of Washington and Mt. Vernon as well as the southern half of the Village of Romeo.

Large tracts of agricultural and vacant land characterize Washington Township. The largest concentrations of up-scale residential development lie south of Twenty Nine Mile Road and west of M-53. Washington Township has grown slowly but steadily over the past forty years with the current population numbering 17,122 residents.

The most outstanding feature attraction in the township is Stony Creek Metropark. Opened in the summer of 1964, the park extends over 4,400 acres of rolling, hilly countryside and inland lakes primarily in Macomb County.

M-53 facilitates rapid north and south transportation, linking Washington Township to Hall Road (M-59) and southern Macomb County. Twenty Six and Thirty Two Mile Roads form the Township's southern and northern boundaries and carry the majority of east and west traffic through the community. The Grand Trunk Western/CN North America railroad operates a rail line through the township that connects the area with the North America rail network. This line will be removed in the future and dedicated for recreational use.

Hazard	CIVIL DISTURBANCE	DROUGHT	EARTHQUAKE	EXTREME TEMPS	TIRE FIRES	STRUCT FIRES	WILDFIRES	DAM FAILURE	RIV / URB FLOODS	SHORELINE FLOODS	HAZMAT FIXED SITE	HAZMAT TRANSPORT	INFRAST FAILURES	NUCLEAR ATTACK	NUCLEAR ACCIDENTS	OIL / GAS PIPE ACC	OIL / GAS WELL ACC	PUB HEALTH EMERG	SABOTAGE / TERRORISM	SUBSIDENCE	HAILSTORMS	LIGHTNING	SEVERE WINDS	TORNADOES	TRANSPO ACCIDENTS	ICE / SLEET STORMS	SNOWSTORMS
Sector																											
Armada Township	X	X	X	X		X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Armada Village	X	X	X	X		X	X		X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Bruce Township	X	X	X	X		X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Center Line Township	X	X	X	X		X	X		X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Chesterfield Township	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Clinton Township	X	X	X	X		X	X		X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Eastpointe	X	X	X	X		X			X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Fraser	X	X	X	X		X			X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
HarrisonTownship	X	X	X	X		X	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	
Lake Township	X	X	X	X		X			X	X			X	X	X	X		X		X	X	X	X	X		X	
Lenox Township	X	X	X	X		X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Macomb Township	X	X	X	X		X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Memphis	X	X	X	X		X	X		X			X	X	X	X	X		X	X		X	X	X	X	X	X	
Mt. Clemens	X	X	X	X		X			X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
New Baltimore	X	X	X	X		X	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	
New Haven Village	X	X	X	X		X	X		X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Ray Township	X	X	X	X		X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Richmond	X	X	X	X		X	X		X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Richmond Township	X	X	X	X		X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Romeo Village	X	X	X	X		X	X		X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Roseville	X	X	X	X		X			X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Shelby Township	X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
St. Clair Shores	X	X	X	X		X			X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	
Sterling Heights	X	X	X	X		X		X	X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Utica	X	X	X	X		X			X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	
Warren	X	X	X	X	X	X			X		X	X	X	X	X	X		X	X		X	X	X	X	X	X	

Washington Township	X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
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SECTOR HAZARDS SUMMARY CHART: 2000

Civil Disturbances

Definition

A public demonstration, gathering, or a prison uprising, that results in a disruption of essential functions, by rioting, looting, arson, or other unlawful behavior.

Hazard Description

Large-scale civil disturbances rarely occur, but when they do they are usually an offshoot or result of one or more of the following events:

- 1) Labor disputes where there is a high degree of animosity between the participating parties,
- 2) High profile/controversial judicial proceedings;
- 3) The implementation of controversial laws or other governmental actions,
- 4) Resource shortages caused by a catastrophic event,
- 5) Disagreements between special interest groups over a particular issue or cause; or
- 6) A perceived unjust death or injury to a person held in high esteem or regard by a particular segment of society.

Prison uprisings are normally the result of perceived injustice by inmates regarding facility rules, operating policies and/or living conditions, or insurrections started by rival groups or gangs within the facility.

Significant or Potential Civil Disturbances

Labor Disputes

Major labor disputes have occurred in virtually every decade in Michigan and Macomb County. However, some have been worse than others in their overall impact on the communities in which they have occurred. Unfortunately, some disputes have turned violent at times, requiring a response by law enforcement agencies to quell the disturbances and maintain order. A recent example of this occurred in Seattle, Washington during the World Trade Organization Conference.

The most recent period of labor unrest in Macomb County has been the Detroit Newspaper Strike, which started in July 1995 and continued on through 1997. This strike had been marked by periods of sporadic violence. The strike negatively impacted many facets of the community and had required extensive use of law enforcement resources, especially the City of Sterling Heights, to supervise strike-related activities and maintain order. The two sides have negotiated a final resolution to this long labor dispute. The most likely communities in Macomb County to experience labor disputes disturbances would be the cities of Warren and Sterling Heights. This conclusion is based on historical data and the industrial base in both communities.

Prison Uprisings

Although violence is a fact of life in Michigan's prisons, large-scale, deadly prison uprisings are relatively rare. Macomb County has one state correctional institution within its boundaries; the Macomb Regional Facility, a medium security facility, located in Lenox Township and one major jail complex, the Macomb County Jail Facility, located in Mount Clemens. Other communities have smaller facilities for detaining potential prisoners.

Political Unrest

The potential for political disturbances in Macomb County is high. The City of Warren is home for the South Campus of Macomb Community College. During the late 1960s, MCC students were very involved in the anti-war movement in the United States. Also located in Warren is the

military installation, the US Army Tank Command, along with firms that have government contracts. A large defense contractor, General Dynamics, is located in the City of Sterling Heights. In Mount Clemens, the county seat, court rulings have sparked social protest, due to court decisions. Located in Harrison Township is Selfridge ANG Base; protests over governmental policies have occurred in the past. The Center Campus of Macomb Community College can be found in Clinton Township. This is the largest community college campus in Michigan and the potential for political protest is significant.

Programs and Initiatives

Civil disturbances are often difficult for local communities to handle. A fine line must be walked between the constitutional right of individuals and groups to assemble and air grievances and the overall needs of the community to provide essential services, ensure personal safety of citizens, prevent property damage, and facilitate normal commerce. Fortunately, most demonstrations and large public gatherings are held in a peaceful, responsible manner. Handling events that could result in civil disturbance is a difficult operation, at best.

Another important element in civil disturbances is proper visual documentation of the incident from start to finish. To that end, many police departments have begun to videotape incidents that could result in a civil disturbance. Such documentation can be used at a later time to identify criminal acts and perpetrators, review actions, and make determinations as to incident cause. In most civil disturbances, local law enforcement resources, augmented where necessary by the Michigan State Police, are sufficient to manage and end the incident.

Prison uprisings are handled first by Michigan Department of Corrections riot units composed of trained Corrections Officers. Additional units may be brought in from other nearby facilities, if necessary, to quell the disturbance. If those resources are not sufficient to manage and end the uprising, specially trained officers from the Michigan State Police can be activated to assist Department of Corrections personnel. The Michigan State Police may also be mobilized to provide perimeter security around the facility, and to augment resource needs.

Analysis and Impact

At the present time, law enforcement agencies augmented by state resources can adequately handle civil disturbances within Macomb County. However, as current events unfold, law enforcement agencies must maintain current skills and equipment needs to counteract potential occurrences. This potential hazard is concurrently addressed in the sabotage/terrorism analysis.

Action Plan

It is recommended that the County's Emergency Management Coordinator meet with the State of Michigan Department of Corrections officials to determine if county support is needed or required. The type of support (police, fire, EMS, and other county related services) should be identified. Communication channels and a formal chain of command should be identified and include a written procedure. Other actions to be taken are addressed in the Sabotage/Terrorism Section.

Drought

Definition

A water shortage caused by a deficiency of rainfall, generally lasting for an extended period of time.

Hazard Description

Drought is a normal part of the climate of Michigan, Macomb County, and of virtually all other climates around the world including areas with high and low average rainfall. This hazard must be analyzed as Macomb County is currently among the top farming counties in Michigan in cash crop commodities such as sweet corn, beans and other produce. Following current trends, the installation of water lines into the northern section of the County along with urban development and the concurrent loss of farmland will reduce the potential of this hazard.

Drought differs from normal conditions found in low rainfall areas in that aridity is a permanent characteristic of that type of climate. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. The severity of a drought depends not only on its location, duration, and geographical extent, but also on the water supply demands made by human activities and vegetation. This multi-faceted nature of the hazard makes it difficult to define a drought and assess when and where one is likely to occur.

Drought differs from other natural hazards in several ways. First, it is difficult to determine the exact beginning and end of a drought, since its effects may accumulate slowly and linger even after the event is generally thought of as being over. Second, the lack of a clear-cut definition of drought often makes it difficult to determine whether one actually exists, and if it does its degree of severity.

Third, drought impacts are often less obvious than other natural hazards, and they are typically spread over a much larger geographic area. Fourth, due primarily to the aforementioned reasons, most communities do not have in place any contingency plans for addressing drought. This lack of pre-planning can greatly hinder a community's response capability when a drought does occur. Droughts can cause many severe impacts for Macomb County:

- Water shortages for human consumption, industrial, business and agricultural uses, power generation, recreation and navigation;
- A drop in the quantity and quality of agricultural crops;
- Decline of water quality in lakes, streams and other natural bodies of water;
- Malnourishment of wildlife and livestock,
- Increase in wildfires and wildfire-related losses to timber, homes and other property,
- Declines in tourism in areas dependent on water-related activities,
- Declines in land values due to physical damage from the drought conditions and/or decreased economic or functional use of the property,
- Reduced tax revenue due to income losses in agriculture, retail, tourism and other economic sectors,
- Increases in insect infestations, plant disease, and wind erosion; and possible loss of human life due to food shortages, extreme heat, fire, and other health-related problems such as diminished sewage flows and increased pollutant concentrations in surface water.

Action Plan

The effects of drought on Macomb County is reduced because of its location to Lake St. Clair and the majority of the population receiving water from the City of Detroit Water System, a very reliable water supply system. The county faces the largest threat from (1) losses in agricultural retail and (2) declines in tourism in areas dependent on water-related activities, such as St. Clair Shores, New Baltimore, Harrison and Chesterfield Townships. Monitoring at this time may be the only action step.

Earthquakes

Definition

A shaking or trembling of the crust of the earth caused by the breaking and shifting of rock beneath the surface.

Hazard Description

Earthquakes range in intensity from slight tremors to great shocks. They may last from a few seconds to several minutes, or come as a series of tremors over a period of several days. The energy of an earthquake is released in seismic waves. Earthquakes usually occur without warning. In some instances, advance warnings of unusual geophysical events may be issued. However, scientists cannot yet predict exactly when or where an earthquake will occur. Earthquakes tend to strike repeatedly along fault lines, which are formed where large plates of the earth's crust below the surface constantly push and move against one another. Risk maps have been produced which show areas where an earthquake is more likely to occur. Earthquake monitoring is conducted by the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, and universities throughout the country.

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from failing objects and debris. Disruption of communications systems, electric power lines, and gas, sewer and water mains can be expected. Water supplies can become contaminated by seepage around water mains. Damage to roadways and other transportation systems may create food and other resource shortages if transportation is interrupted. In addition, earthquakes may trigger other emergency situations such as fires and hazardous material spills, thereby compounding the situation.

Significant Earthquakes

No severely destructive earthquake has ever been documented as centered in Macomb County or in the State of Michigan as per the Michigan Hazard Analysis, EMD Pub-103, October 1998. No action plan or mitigation efforts are proposed other than strict enforcement of local building codes and improving shelter provisions for county residents in the event of a major New Madrid Seismic Event.

Extreme Temperatures

Definitions

Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions.

Hazard Description

Prolonged periods of extreme temperatures, whether extreme summer heat or extreme winter cold, can pose severe and often life-threatening problems for Macomb County's citizens. Although they are radically different in terms of initiating conditions, the two hazards share a commonality in that they both primarily affect the most vulnerable segments of the population, the elderly, children, impoverished individuals, and people in poor health. Due to their unique characteristics, extreme summer heat and extreme winter cold hazards will be discussed individually.

Extreme Summer Heat

Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. When persisting over a long period of time, this phenomenon is commonly called a heat wave. The major threats of extreme summer heat are heatstroke (a major medical emergency), and heat exhaustion. Heatstroke often results in high body temperatures, and the victim may be delirious, stuporous, or comatose. Rapid cooling is essential to preventing permanent neurological damage or death. Heat exhaustion is a less severe condition than heatstroke, although it can still cause severe problems such as dizziness, weakness and fatigue. Heat exhaustion is often the result of fluid imbalance due to increased perspiration in response to the intense heat. Treatment generally consists of restoring fluids and staying indoors in a cooler environment until the body returns to normal. Other, less serious risks associated with extreme summer heat are often exercise-related and include heat syncope (a loss of consciousness by persons not acclimated to hot weather), and heat cramps (an imbalance of fluids that occurs when people unaccustomed to heat exercise outdoors).

The combined effects of high temperatures and high humidity are more intense in urban centers; heatstroke and heat exhaustion are a greater problem in cities than in suburban or rural areas. Nationwide, approximately 200 deaths a year are directly attributable to extreme heat. Extreme summer heat is also hazardous to livestock and agricultural crops, and it can cause water shortages, exacerbate fire hazards, and prompt excessive demands for energy. Roads, bridges, railroad tracks and other infrastructure are susceptible to damage from extreme heat.

Air conditioning is probably the most effective measure for mitigating the effects on extreme summer heat on people. Many of those most vulnerable to this hazard do not live or work in air-conditioned environments, especially in major urban centers where the vulnerability is highest. The use of fans to move air may help some, but recent research indicates that increased air movement may actually exacerbate heat stress in many individuals.

Extreme Winter Cold

Like heat waves, periods of prolonged, unusually cold weather can result in a significant number of temperature-related deaths. Each year in the United States, approximately 700 people die as a result of severe cold temperature-related causes. This is substantially higher than the average of 200 heat-related deaths each year. It should be noted that a significant number of cold-related deaths are not the direct result of "freezing" conditions. Rather, many deaths are the result of illnesses and diseases that are negatively impacted by severe cold weather, such as stroke, heart

disease and pneumonia. It could convincingly be argued that, were it not for the extreme cold temperatures, death in many cases would not have occurred at the time it did from the illness or disease alone.

Hypothermia (the unintentional lowering of core body temperature), and frostbite (damage from tissue being frozen) are probably the two conditions most closely associated with cold temperature-related injury and death. Hypothermia is usually the result of over-exposure to the cold, and is generally thought to be clinically significant when core body temperature reaches 95 degrees or less. As body temperature drops, the victim may slip in and out of consciousness, and appear confused or disoriented. Treatment normally involves re-warming the victim, although there is some controversy in the medical community as to exactly how that should be done. Frostbite rarely results in death, but in extreme cases it can result in amputation of the affected body tissue.

Hypothermia usually occurs in one of two sets of circumstances. One situation involves hypothermia associated with prolonged exposure to cold while participating in outdoor sports such as skiing, hiking or camping. Most victims of this form of hypothermia tend to be young, generally healthy individuals who may lack experience in dealing with extreme cold temperatures. The second situation involves a particularly vulnerable person who, is subjected to only a moderate, indoor cold stress. A common example would be that of an elderly person living in an inadequately heated home. In such circumstances, hypothermia may not occur until days or perhaps weeks after the cold stress begins.

The special vulnerability of elderly persons to hypothermia has become readily apparent. Over half of the approximately 700 persons who die each year due to cold exposure are 60 years of age or older, even though this age group only represents about 20% of the country's population. This remarkable statistic may be due, in part, to the fact that elderly persons appear to perceive cold less well than younger persons and may voluntarily set thermostats to relatively low temperatures. In addition, high energy costs and the relative poverty among some elderly people may discourage their setting thermostats high enough to maintain adequate warmth. Because many elderly people live alone and do not have regular visitors, the cold conditions may persist for several days or weeks, thus allowing hypothermia to set in.

Babies and very young children are also very vulnerable to hypothermia. In addition, statistics indicate that death due to cold is more frequent among males than females in virtually all age groups. Part of that may be explained by differences in risk factors, and part may be due to different rates of cold exposure between the sexes.

Significant Events

Extreme Summer Heat

Although Macomb County has been fortunate not to have a heat wave that resulted in numerous deaths, the potential always exists for such an event to occur. In recent years, many other areas of the country have experienced such events, and the results have, unfortunately, been tragic.

Extreme Winter Cold

Deaths due to extreme winter cold are often not associated with a particular weather event. Rather, they are the result of a one-time overexposure to severe cold weather (a hiker lost in the woods), or more commonly from continuous exposure to moderate cold temperatures by vulnerable persons (such as the elderly or the homeless). In some cases, hypothermia deaths can be linked to severe winter weather such as snowstorms or blizzards, where the victim is caught unprepared for the extreme cold temperatures. As mentioned earlier, many cold temperature-related deaths involve the exacerbation of an existing, serious medical condition such as heart disease or pneumonia.

Action Plan

Extreme Summer Heat

Heat waves severe enough to threaten health do not occur every year, and several relatively mild summers may intervene between major heat waves. This erratic occurrence hinders effective planning and prevention efforts. The problem is further complicated by the fact that long-term weather forecasts cannot reliably predict prolonged periods of extreme summer heat. Short-term forecasts of hot weather are more accurate, but often leave little time for mobilizing the effort needed to effectively combat the hazard.

Extreme Winter Cold Temperature

Extreme winter cold temperature is a universal hazard in Michigan and Macomb County. Whereas heat waves tend to impact urban centers more than suburban or rural areas, cold temperatures are an "equal opportunity" killer. Every community in Michigan and Macomb County is vulnerable, regardless of location or size. The county's Emergency Management Coordinator will work with the County's Public Health Department and local community groups to provide aid to residents in distress. The American Red Cross has identified heating and cooling shelters. Also, the county provides local government buildings to shelter persons who need protection from extreme low temperatures. The county's Emergency Operations Plan should address this issue in the annual review to be conducted by the county's Assistant Emergency Management Coordinator. Further action should include the updating of senior citizens lists by local senior citizens groups to determine if visits to the elderly are required.

Scrap Tire Fires

Definition

A large fire that burns scrap tires being stored for recycling/re-use.

Hazard Description

With the disposal of an estimated 250 million vehicle tires annually in the United States, management of scrap tires has become a major economic and environmental issue. Michigan generates some 7.5 to 9 million scrap tires each year. Although responsible means of disposal have become more common, tire dumps of the last forty years present environmental and safety hazards that will last into the foreseeable future. The state of Michigan has identified a total in excess of 15 million scrap tires in disposal sites scattered around the state.

Issues pertaining to the management of scrap tire disposal sites are difficult and diverse. Whole tires are difficult to landfill because they tend to float to the surface. Whole tires are banned by many licensed landfills due to associated problems. In addition, scrap tires are breeding grounds for mosquitoes, which can reproduce at 4,000 times their natural rate in a scrap tire disposal site. From an emergency management perspective, the most serious problem that scrap tire disposal sites pose is that they can be a tremendous fire hazard if not properly designed and managed.

Tire disposal sites can be fire hazards due to the large number of tires typically present at a site. This large quantity of "fuel", coupled with the fact that the shape of a tire allows air to flow into the interior of a large tire pile, renders standard fire fighting practices nearly useless. Flowing burning oil released by the tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue that can leach into the soil, creating long-term environmental problems.

Scrap tire fires differ from conventional fires in several respects:

- 1) Even relatively small scrap tire fires can require significant resources to control and extinguish,
- 2) The costs of fire management are often far beyond that which local government can absorb,
- 3) The environmental consequences of a major tire fire are significant; and
- 4) As alluded to earlier, the extreme heat converts a standard passenger vehicle tire into about two gallons of oily residue, which can leach into the soil or migrate to streams.

Current technologies are beginning to address the reuse of scrap tires, but more often than not waste tires migrate to the least expensive disposal method, which usually means they end up in a scrap tire disposal site.

Analysis and Impact

Even with the improvements to the State's regulatory authority brought about by the recent legislative changes, much work still needs to be done to mitigate the impacts of scrap tire fires. Incident management planning, recognition of the hazardous material potential of fires at scrap tire sites, and improving/enhancing disposal site selection and design processes are all critical pre-incident preparedness factors that must be addressed by government and the private sector. In light of the potential consequences of scrap tire fires, prevention must become a primary goal in the treatment of scrap tire disposal sites.

Scrap Tire Management

To be effective, scrap tire management must be viewed from two perspectives. First, methods for dealing with the millions of scrap tires currently being generated must be devised to

stop the problem from growing in scope and magnitude. Recycling and re-use appear to be the best options in that regard, but those solutions may not be completely practical and effective for some time. Second, measures must be devised to address the issues pertaining to the millions of scrap tires already present in existing disposal sites. In developing such a corrective solution, the economic realities of the problem must be understood.

The vast majority of disposal site owners have neither the financial means nor the incentive to address the health and fire hazards that result from the storage of scrap tires on their property. Unless the value of the tires increases dramatically through technological development (an unlikely situation in the foreseeable future), the piles will continue to grow, exacerbating the health and safety hazards for surrounding communities.

Action Plan

To combat these problems at current disposal sites, suggestions have been made about establishing a state policy and program for acquiring such sites and suitably disposing of the millions of tires at these locations. Other proposals call for educating local jurisdictions on the hazards associated with scrap tire disposal sites so that enforcement of existing legislation is effective in minimizing future potential scrap tire fires. In Macomb County, the only community identified with a significant storage of tires is the City of Warren. Proper application of the BOCA (Building Officials and Code Administrators) Fire Prevention Code, by the local fire department, should reduce the effects of a tire fire in their community.

Structural Fires

Definition

A fire, of any origin, that ignites one or more structures, causing loss of life and/or property.

Hazard Description

In terms of average annual loss of life and property, structural fires, often referred to as the "universal hazard" because they occur in virtually every community, are by far the biggest hazard facing most communities in Macomb County. According to the National Fire Protection Association, structural fires cause more loss of life and property damage than all types of natural disasters combined. Direct property losses due to fire exceed \$9 billion per year and much of that figure is the result of structural fire.

Macomb County's fire experience generally mirrors the national and Michigan's fire situation. According to statistics compiled by the Fire Marshal Division, Michigan Department of State Police, nearly 59,000 structural fires occurred in Michigan in 1996-97, resulting in 290 deaths and 1,385 injuries. Dollar losses for structural fires alone were estimated at nearly \$874 million. The Fire Marshal Division estimated that a structural fire occurred in Michigan every 26 minutes, 29 seconds in 1997. Nationally, Michigan's fire death rate in 1995 of 22 persons per million population puts it in the upper third of all states in the nation.

Although structural fires occur everyday in Macomb County, what is significant about these particular fires is the disastrous impact they have on the communities. In many cases, the very lifeblood of the community's business and retail districts was destroyed or severely damaged, affecting not only the structures themselves, but also the community economy as well. Adding insult to injury is the fact that some of these businesses never re-opened, leaving a permanent scar on the community. A recent example of this occurred in Eastpointe, where a metal plating facility caught fire. Contents of the building included dangerous cyanides used in the electroplating operations. Clean-up costs approached nearly one million dollars and indirect loss of business and services placed a heavy burden on the city's resources.

Analysis and Impact

State and local fire service efforts in the areas of training, public education, incident command, construction plan review, site inspection and fire analysis are all oriented toward, and contribute to, structural fire mitigation and prevention. However, like most programs, the amount of work that can be done is directly related to funding and program priorities.

Action Plan

Macomb County is very pro-active in its fire prevention efforts. The Macomb County Fire Inspector's Association conducts monthly meetings and sponsors training programs. Macomb Community College recently added, to its fire science curriculum courses to improve the efficiency of fire inspections and building plan reviews. There is common agreement among communities in Macomb County that sources of funding be identified to increase training for fire, building, planning, and zoning officials as this would provide the most cost effective method to mitigate structural fire hazards.

Wildfires

Definition

An uncontrolled fire in grasslands, brush lands or forested areas.

Hazard Description

Outdoor burning is the leading cause of wildfires in Macomb County. Most Macomb County wildfires occur close to where people live and recreate, which puts both people and property at risk. The immediate danger from wildfires is the destruction of timber, property, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area.

Analysis and Impact

Historically, Macomb County has reduced wildfire vulnerability by restricting open burning of trash and yard debris (which causes nearly one-third of the wildfires in the state), and developing evacuation procedures for wildfires in the jurisdictions Emergency Action Guidelines (EAG) to minimize potential injury and loss of life.

Enforcement of present banning of open burning or burning by fire department approval has resulted in Macomb County having one of the lowest wildfire loss rates in the state. One area of concern is the marsh located near Metropolitan Park in Harrison Township. Fires in the marsh are difficult to control due to inaccessibility for fire apparatus. No further mitigation action should be taken. Monitoring reports would be recommended and encouraging strict control of open burning with fire department approval.

Action Plan

Macomb County has experienced minor damage as the result of wildfires. The county's Emergency Management Coordinator will monitor, through the State Fire Marshal Annual Fire Report, any significant increase in the number of wildfires. No other action is recommended at this time.

Dam Failures

Definition

The collapse or failure of an impoundment, resulting in downstream flooding.

Hazard Description

A dam failure can result in loss of life and extensive property or natural resource damage for miles downstream from the dam. Dam failures occur not only during flood events, which may cause overtopping of a dam, but also as a result of poor operation, lack of maintenance and repair, and vandalism.

Analysis and Impact

Dams are important components of the county's infrastructure and provide benefits to all residents. However, as history has demonstrated, dams can fail with disastrous consequences, causing unfortunate loss of life, property and natural resources. Many existing dams are getting older, and constant repair and maintenance is required. At the same time, development continues in potential inundation zones downstream from dams. There are more people at risk from dam failure than ever before despite better engineering and construction methods. As a result, continued loss of life and property can be expected to occur. The challenges facing county emergency management officials are:

- Minimize loss of life and property by working closely with dam owners in the development of the EAG's (Emergency Action Guidelines) to ensure consistency with the Emergency Action Guidelines (EAG) for the jurisdiction.
- Developing procedures in the EAG for responding to a dam failure (including a site-specific standard operating procedure for each dam site).
- Participating in dam site exercises; and
- Increasing public awareness of dam safety procedures.

The Michigan Hazard Analysis, EMD Pub-103, October 1998, identified two "High Hazard" dams and two "Significant Hazard" dams in Macomb County (Map location at the end of this section). The two "High Hazard Dams" belong to the Huron-Clinton Metropark Authority (Stony Creek). The Metropark Authority drained the lakes in 1998 and performed repairs to the dam.

Two dams that were classified as "Significant Hazards" were identified as the Cory Lake Dam, located in Washington Township, owned by private homeowners and Autumn Ridge Dam, owned by a governmental unit. At this time, it has not been determined if the City of Sterling Heights or Macomb County is responsible for the Autumn Ridge Dam. Also, the private owners of the Cory Lake Dam have not been identified.

Action Plan

Mitigation of hazards associated with dam failure will vary depending on whether the hazard is associated with a new or an existing dam. New dams can be designed to meet stringent safety criteria, including passage of extreme flood discharges. Addressing hazards associated with existing dams often is problematic, especially when ownership cannot be determined. The primary mechanism is development of EAG's focused on evacuation of people and closure of roads.

The County Emergency Management Coordinator will work with local emergency managers of Washington Township, the City of Sterling Heights and the Macomb County Public Works Commission to determine ownership of the dams classified as "Significant Hazards" and develop an EAG for both sites. Work being performed on the "High Hazard" dams at Stony Creek (Huron-Clinton Metropark Authority) will be monitored by the County Emergency Manager until completion. An effort should be made to re-evaluate the "High Hazard" rating given to the Stony Creek Metro Park dams.

Riverine/Urban Flooding

Definition

The overflowing of rivers, streams, drains and lakes due to excessive rainfall, rapid snowmelt or ice.

Hazard Description

Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for serious flooding because rainfall that used to soak into the ground or take several days to reach a river or stream via a natural drainage basin now quickly runs off streets, parking lots, and rooftops, and through man-made channels and pipes.

Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. Long-term collateral dangers include the outbreak of disease, widespread animal death, broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fires, and the release of hazardous materials.

Flood prone areas are found throughout the county, as every lake, river, stream and county drain has a floodplain. The type of development that exists within the floodplain will determine whether or not flooding will cause damage. The Michigan Department of Environmental Quality estimates that about 6% of Michigan's land are flood-prone, including about 200,000 buildings. The southern half of the Lower Peninsula, where Macomb County is located, contains the areas with the most flood damage potential.

The primary flooding sources include the Great Lakes and connecting waters (Detroit River, St. Clair River, and St. Marys River), thousands of miles of rivers and streams, and hundreds of inland lakes. Michigan is divided into 63 major watersheds. All of these watersheds experience flooding, although the following watersheds have experienced the most extensive flooding problems or have significant damage potential:

- 1) *The Clinton River, in Macomb County;*
- 2) Ecorse Creek;
- 3) Grand River;
- 4) Huron River;
- 5) Kalamazoo River;
- 6) Muskegon River;
- 7) Saginaw River;
- 8) Rifle River;
- 9) River Raisin;
- 10) Rouge River;
- 11) St. Joseph River
- 12) Whitefish River.

The flooding is not restricted to the main branches of these rivers. Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snow-melt. Ice jams also cause flooding in winter and early spring. Severe thunderstorms may cause flooding during the summer or fall, although these are normally localized and have more impact on watercourses with smaller drainage areas. Oftentimes, flooding may not necessarily be directly attributable to a river, stream or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall and/or snow-melt, saturated ground, and inadequate drainage.

The water, with no place to go, will find the lowest elevations, areas that are often not in a floodplain. That type of flooding is becoming increasingly prevalent in Macomb County, as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns. In Macomb County, the communities of Harrison Township, St. Clair Shores, Fraser, Clinton Twp., Chesterfield Township, Macomb Township, Roseville, Eastpointe, and Mt. Clemens have often experienced this type of problem.

Macomb County is ranked number one of all Michigan counties in flood Insurance coverage. Harrison Township (1) St. Clair Shores (2) and Chesterfield Township (8) are in the top ten of Michigan communities in flood insurance coverage. Harrison Township (2) and St. Clair Shores (3) are listed in the top ten of Michigan communities in the number of flood insurance policies.

Historical Background

Macomb County has a history of natural disasters that has led to flooding. Severe windstorms, thunderstorms, tornadoes, winter snowstorms and heavy rainfalls have beset Macomb County:

- In February 1998, an early winter thaw coupled with an unusually high rainfall caused numerous communities to experience flooded homes and waterways.
- In 1997, unusually high water levels in Lake St. Clair resulted in the initiative "*Flood Fight 1997*."
- August 1995, major flooding due to heavy rains totally submerged cars on local freeways.
- January 1993, early thaw due to unusually warm weather coupled with heavy rains created major flooding problems.
- February 1986, a Governor's Declaration was issued due to flooding of the Great Lakes and Lake St. Clair.
- September 1986, a Presidential Emergency Disaster was declared due to major flooding.
- April 1985, a Governor's Declaration was declared due to flooding on Lake St. Clair.
- October 1981, major flooding in county due to heavy rains - SBA loans available.
- April 1975, a Presidential Emergency Disaster was declared due to rain, flooding, and tornadoes.

Analysis and Impact

Riverine and urban flooding was rated as the number one hazard for the following communities:

- Chesterfield Township,
- Clinton Township,
- Eastpointe,
- Fraser,
- Harrison Township,
- Macomb Township,
- Mt. Clemens,
- New Baltimore,
- Roseville,

- St. Clair Shores, and
- Utica

Many of the communities, such as Macomb, Clinton, Harrison and Chesterfield Townships and the cities of St. Clair Shores, and Fraser, are proactive in mitigating flood problems. The County of Macomb is requiring retention and detention facilities in new development to reduce the effects of heavy rainfalls in flood-prone areas. Encouragement must be given to the northern communities to carefully avoid building structures in flood plains and use flood plain areas for recreational use as Macomb and Clinton Townships. Special efforts should be made to supply residents of Harrison Township with funds to elevate homes out of the flood plain. Efforts of local communities for mitigating flood damage should be recognized along with the realization that much can be done to reduce the damage caused by flooding to even a lower level.

Currently, the Village of Armada, Ray Township, and Lenox Township participate in the National Flood Insurance Program (NFIP), although, there are only two flood insurance policies currently in force. The Township of Armada does not participate in the NFIP. As a result, flood insurance is not available. It is suggested that the flood-prone map be made available at the community level to increase awareness in flooding potential. It is recommended that the Township of Armada consider joining the NFIP to make flood insurance available to the Township's residents. It is suggested that, for those roads that may be critical to health and safety, alternative routes are determined in advance of flooding conditions.

Warning Systems

Presently, Macomb County relies on the National Weather Service for flood warning. Historically, Macomb County has suffered flood damage during periods of high lake levels, which allows communities time to take action. Urban flooding, due to storm sewer backup, has a shorter preparedness time factor. The National Weather Service, under N.O.A.A. and the U. S. Department of Commerce has installed three river gage stations to monitor the water level depths of the Clinton River and to deliver a warning when the river has reached flood stage levels. These three gages are at the following locations: Macomb Township, north of Hall Road and west of North Avenue; Clinton Township, north of Utica Road and east of Hayes; Clinton Township, east of Moravian and south of Cass.

NFIP Repetitive Loss Properties in Macomb County

(Confidential information - not authorized for release)

Action Plan

Flood Management Goals

The major flood management goals include the following:

1. Improve the county's planning and mapping capabilities to identify flood problem areas to mitigate flood losses and to encourage redevelopment that would reduce repetitive losses.
2. Land acquisitions, relocation and elevating homes and redevelopment of structures identified as repetitive losses. Strong efforts have been made by local communities.

Planning/Mapping

The Office of Emergency Management has been working with the County's Planning Department and the planning commissions of local governments to mitigate potential flooding problems in Macomb County. The following projects have been identified and are in planning stages or in development that would "mitigate" hazards in Macomb County. Many of these projects affect not only Macomb County, but Southeastern Michigan and the Great Lakes Region as well. Descriptions of the projects include objectives, benefits, and location (areas affected). The County's Department of Planning and Economic Development is developing a County-Wide Geographic Information System (GIS) For Disaster Mitigation and Emergency Response Planning. Through the development of a county-wide Geographic Information System a tool set consisting of highly accurate electronic maps and databases, tied to exact locations on the earth surface, could be made available to county agencies and local communities as a disaster mitigation planning tool. Such a system could be utilized for:

- Identifying flood plain and shoreline areas prone to natural flooding.
- Inventorying potential sites for man-made disasters.
- Surface water-modeling for flood control/storm water management.
- Improving siting of new facilities such as schools, hospitals in lower risk areas.
- Identifying the spatial relationships between residential, special populations, potential hazards and emergency services.
- Emergency response planning and routing.
- Pre/Post disaster coordination and dispatching of intergovernmental emergency responders.

The creation of a county wide geographic information system with the ability to perform these functions requires the following elements:

- County wide aerial digital orthophotography to support development of:
 - Parcel map layer depicting location, land use, property value and ownership
 - Road centerline/address map layer depicting the locations of all roads in the county with their addresses for emergency services routing and planning
 - County-wide hydrography map layer depicting the locations of all water courses, flood control devices, storm water control devices and shoreline areas
 - County-wide topographic contour map for watershed modeling and flood response planning
- Computer hardware and software for development, analysis and distribution of above data/map sets consisting of:
 - High end file server for storage of data sets and digital orthophotography
 - High end workstations for the development and maintenance of new and existing data/map sets
 - Workstations for performing queries and developing plans

- ArcInfo® and ArcView® software for developing, maintaining and distributing data/map sets.
- The first stage of this project will begin in spring of 2000 and continue throughout the decade.

Land Acquisitions, Relocation and Elevating Homes and Redevelopment

Communities in Macomb County are presently purchasing homes and property located in the Clinton Watershed. These purchases have removed flood-prone structures and returned the property back to its natural state to be used as parks.

These sites are located in Macomb and Clinton Townships. Macomb Township is the fastest growing community in Michigan. Clinton Township has the largest population of any township in Michigan. Purchase of property, before development, to be used to mitigate the flood hazard is critical at this time, before development has consumed available property.

Harrison Township has identified approximately 5 residential units that are located in flood-prone areas that have flooded many times (repetitive loss properties) and have made claims under the National Flood Insurance Program. Presently, two public facilities have been identified in Harrison Township that are located in flood-prone areas: Harrison Fire Station 2 and St. John's Hospital. The Township of Harrison is planning to build a new fire station out of the flood plain area and St. John's Hospital, which is not a primary care facility, is developing evacuation plans to remove their ambulatory patients.

An analysis conducted, in December of 1999 by the Land & Water Management Division of the Michigan Department of Environmental Quality, notes about 20 to 25 houses that may be currently within the 100-year floodplain of the Coon and Deer Creek Watersheds in northern Macomb County. The Flood Mitigation Assistance Program and the Hazard Mitigation Grant Program both may be used to purchase, relocate, or flood-proof homes that are prone to flooding.

Benefits

Purchase of property located in the floodplain will reduce the amount of water entering the Clinton Watershed, thus mitigating flood hazards for Macomb County. Homes and property valued at an estimated cost of \$2,000,000 have been identified as potential sites to assist local communities in mitigating the flood hazard.

Redevelopment and Zoning

Clinton and Macomb Townships have re-zoned flood-prone areas in their respective townships for recreational use. Clinton Township has purchased property and developed a park system for their residents to use while allowing a passive water detention to co-exist. Clinton Township is presently developing a recreational site, in a flood-prone area, at Clinton River Road and Canal Road and is seeking Federal recognition as a historical site.

Macomb Township has zoned the flood-prone areas along the North and Middle Branch of the Clinton River for use as golf courses. This mitigation technique allows for recreational use of flood prone areas and allows the land to be used for recreational use while increasing property values around these areas.

In the northern portion of Macomb County, the Emergency Management Office is working with community leaders to redevelop areas that are located within the flood plain. The direction is toward developing potential flood-prone property into recreational use. Creation of a regional park has taken place along with the development and planning for recreational facilities such as golf courses.

Sanitary Flood Mitigation

The City of St. Clair Shores has recently passed a bond issue authorizing repairs to their local sewer system. The local sewer systems within St. Clair Shores are composed of separated and combined systems. Flow from the systems are conveyed to four major interceptors: 1) the Martin Drain, 2) 9 Mile Drain, 3) the 8 ½ Mile Drain and 4) the Jefferson Interceptor.

Two combined sewer retention treatment basins (RTBs), Martin and Chapaton, serve southern Macomb County. These RTBs were constructed in 1969 and receive excess flows from combined sewer areas during storms. The captured water is dewatered to the sanitary sewer system after the storm. During large storms, water will flow into the RTBs, receive primary treatment and disinfection and then overflow into Lake St. Clair. The Martin RTB has a volume of 8.6 million gallons. The Chapaton RTB has a volume of 28 million gallons. The Martin RTB serves the area tributary to the Martin Drain and the Chapaton RTB serves the area tributary to the 8-1/2 and 9-Mile Drains. The Jefferson Interceptor serves as the direct outlet for most of the separated sewer system in St. Clair Shores and the outlet for the sanitary. It also combines flows from the Martin and Chapaton Districts and the RTB dewatering outlet.

Ever since 1994, Lake St. Clair has experienced high bacteria levels, which has caused the closing of public beaches for swimming. During periods of heavy rainfall, basements are repeatedly flooded. The sanitary system as it presently exists does not fulfill the needs of the community. It is overburdened because it has been outgrown.

Pump Stations Improvements

The City of Fraser has identified a problem with its sanitary sewer overflow discharge point at its Beacon Pump Station located at Beacon Lane and Masonic. During periods of heavy rain, sanitary sewage is allowed to enter the storm sewer. This is the same storm system that goes into the Clinton Drain and then into Lake St. Clair which relates to the health and safety issues at hand. If this sewage is not permitted to go to the storm sewer, the basements of the residents in the area will flood.

Action to amend this situation is highly recommended. It would involve the installation of valves to ensure that pumps discharge to the sanitary sewer system.

Chesterfield and Clinton Townships have identified similar problems with pump stations. Chesterfield's Schmidt Pump Station and Clinton Township's Bridgewood Pump Station require improvements to prevent urban flooding.

Clinton Township is presently managing a \$30,000,000.00 improvement to its sanitary sewer system. Work began in the spring of 2001.

Bank Stabilization

The Macomb County Public Works Office Flood Mitigation Projects include the bank stabilization and existing channel modification of two miles of the Middle Branch of the Clinton River. This would provide a 100 year storm flood way flow improvements. This will also include blockage removal and bank flow characteristic improvements in Macomb and Clinton Townships.

The Public Works Office also identified bank stabilization, in Clinton Township, of approximately 2,000 feet of flood channel to improve bank and channel flow characteristics during 100-year storm flood events.

Shoreline Flooding and Erosion

Definition

The flooding and erosion of shoreline areas caused by high Great Lakes water levels, storm surges, or winds.

Hazard Description

Michigan has over 3,200 miles of coastline (the longest freshwater coastline in the world) that is home to more than 4.4 million people. Wind, waves, and water level constantly affect the communities along the shores of the Great Lakes. Shoreline flooding and erosion, as natural processes, occur at normal and even low Great Lakes water levels. However, during periods of high water, flooding and erosion are more frequent, causing serious damage to homes and businesses, roads, water and wastewater treatment facilities, and other structures in coastal communities. Long-term and seasonal variations in precipitation and evaporation rates contribute to the fluctuation of Great Lakes' water levels.

The Great Lakes occupy an area of 95,000 square miles and drain an amount of land twice that size. They hold nearly one-fifth of the world's fresh surface water. Because the land draining into the Great Lakes is so vast, changes in the amount of water running into the lakes from precipitation within the basin has an enormous effect on water levels. Following long periods of above average yearly precipitation, there is an accompanying rise in water levels. This rise is not immediately evident because of the delay between the time precipitation falls within the drainage basin and the time that runoff waters enter the lakes. (The same holds true for below average yearly precipitation. The lessened flow of runoff water becomes evident in lower Great Lakes' water levels. Presently, Lake St. Clair is 5 inches below normal.)

Over one hundred years of record keeping have indicated no regular, absolutely predictable cycle of levels. The time between periods of high and low water levels can vary widely. Records indicate the maximum differences in levels have varied from nearly four feet on Lake Superior to over six and one-half feet on Lakes Michigan and Huron. Seasonal fluctuations caused by more water runoff can cause lake level fluctuations averaging about one foot on Lakes Superior, Michigan and Huron, and one and one-half feet on Lake Erie. Weather-related events can also cause fluctuations that can last from several hours to several days. For example, windstorms combined with differences in barometric pressure can temporarily tilt the surface of a lake up at one end as much as eight feet. This phenomenon is called a storm surge and can drive lake waters inland over large areas.

In addition to natural causes of water level fluctuation, there are three man-made factors that can also affect water levels to some degree:

- 1) Diversion of water for power generation, municipal water supply, and navigation;
- 2) Regulation of water levels via dams and other control structures; and
- 3) Dredging of connecting waterways for navigation purposes.

Although these man-made factors do impact water levels, natural factors such as precipitation, evaporation and winds have a far greater overall impact. The vast majority of shoreline flooding and erosion that occurs along the Great Lakes is caused by natural factors. However, it should be remembered that it is humans that place themselves in harm's way by building structures in dynamic shoreline areas. If that did not occur, there would not be a significant shoreline flooding or erosion problem in Macomb County.

Generally, low-lying lands along the coastline, such as the city of St. Clair Shores, Harrison and Chesterfield Townships, are prone to shoreline flooding during both high and low lake water periods. The Michigan Department of Environmental Quality estimates that approximately 10% of

Michigan's Great Lakes shoreline (30 counties encompassing greater than 45,000 acres) is flood-prone.

Significant Periods of Shoreline Flooding and Erosion

In nearly every decade, high water levels on the Great Lakes have caused significant damage and impact to Macomb County's coastal communities. The most recent high water period began in 1997 and resulted in the Great Lakes being at or near record levels set in the mid-1980s'. In response to the threat of severe shoreline flooding and erosion, the U.S. Army Corps of Engineers (USACE), at the request of the Governor, implemented its Advance Measures Program to assist Michigan shoreline communities in their flood and erosion mitigation efforts.

Programs and Initiatives

Michigan Shoreline Flood and Erosion Hazard Regulatory Shorelands Protection and Management, Part 323 of the Natural Resources and Environmental Protection Act, 451 P.A. 1994, as amended.

Part 323 is designed to provide protection to Michigan's Great Lakes shoreline. While these fragile and dynamic shorelines are desirable vacation and recreational areas, they also present inherent hazards to development and are vulnerable to the development that use often brings. Part 323 gives the MDEQ responsibility to identify hazardous and fragile coastal areas and establish regulations designed to minimize the impact of development on these areas, and to minimize the hazard facing development. Part 323 identifies three shoreline areas:

- 1) High-risk erosion areas, those shorelines identified as receding at an average long-term rate of one foot per year.
- 2) Flood risk areas, those coastal areas that are vulnerable to Great Lakes flooding; and
- 3) Environmental areas, those coastal areas necessary for the preservation and maintenance of fish and wildlife. Regulations have been developed for the unique management issues facing each area.

Mechanisms provided in the law to accomplish this protection are state-developed zoning ordinances, special studies, plans, and remedies for violation of rules. The Act gives the MDEQ the authority to identify and regulate high-risk erosion, flood, and environmental areas using setbacks, zoning and building code standards. Permits are required for construction in high-risk erosion or flood areas, or for alterations in an environmental area. If a local ordinance has been approved by the MDEQ, the regulation will be done at the local level. In the absence of a local ordinance, permits must be obtained from the MDEQ.

Action Plan

Macomb County has very little shoreline that is exposed to erosion problems. Areas have been identified in St. Clair Shores, Chesterfield and Harrison Townships. Officials in those communities are aware and are monitoring the threat. The county's Emergency Management Coordinator, working with local community leaders, will monitor shoreline erosion if it occurs and take appropriate action.

Hazardous Materials Incidents-Fixed Sites

Definition

Hazardous materials are materials or substances which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released.

Hazard Description

Over the past few decades, new technologies have developed at a stunning pace. As a result, hazardous materials are present in quantities of concern in business and industry, agriculture, colleges, hospitals, utilities, and other facilities in Macomb County. This trend will continue into the future, as manufacturing is the leading industry in Macomb County.

Hazardous materials are materials or substances which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gasses.

Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general public and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use, and disposal of these materials, accidental releases do occur. Often, these releases can cause severe harm to people or the environment if proper mitigative action is not immediately taken. Most releases are the result of human error. Occasionally, releases can be attributed to natural causes, such as a flood that washes away barrels of chemicals stored at a site. However, those situations are the exception rather than the rule.

Significant Fixed-Site Hazardous Material Incidents

Macomb County has had numerous fixed-site hazardous material incidents that required a response by local fire departments and hazardous material response teams, and many required the implementation of evacuation and other protective actions.

A reportable hazardous material incident is one in which all three of the following conditions apply:

- 1) A material is present that is suspected to be other than ordinary combustible by-product material.
- 2) The material is in such a state, quantity or circumstance that, if left unattended, it is presumed to pose a threat to life, health, property or the environment; and
- 3) Special hazardous material resources were dispatched or used, or should have been dispatched or used (for assessing, mitigating or managing the situation.)

Significant Fixed-Site Hazardous Material Incidents in Macomb County

- On October 24, 1988, a chemical spill in St. Clair Shores, at a plant injured 40 people and forced an evacuation of the site.
- June 17, 1983, a fire at a hazardous waste site caused six injuries and forced the evacuation of 1,200 people.

Action Plan

One of the major provisions of SARA Title III is the establishment of a Local Emergency Planning Committee (LEPC) for designated planning districts. Macomb County has a Local Emergency Planning Committee. The LEPC is responsible for developing emergency response plans for those facilities in their jurisdiction subject to SARA Title III emergency planning

requirements. A facility is subject to SARA Title III provisions if extremely hazardous substances (as determined by the U.S. Environmental Protection Agency) are present at the facility in quantities at or above the minimum threshold quantities established in Section 302 of the Act.

Each Section 302 site must be covered by a response plan that addresses the emergency planning requirements found under SARA Title III. At the time that this study was conducted, the Macomb County LEPC, under the direction of the County's Emergency Management Coordinator, was pro-active in developing plans for its 302 Sites. Computer equipment and software has been purchased and personnel assigned to complete this planning function.

Macomb County Emergency Management hired, in January-2002, an additional person to assist in recognizing and identifying Section 302 sites and developing emergency hazmat response plans per SARA Title III planning requirements. This planning process is estimated to be an initiative that would span a two-year time frame. The Office of Emergency Management for Macomb County will work with the Local Emergency Planning Committee (LEPC) to develop pre-response plans for hazardous material first responders. An overview of the 302 sites in Macomb County follows.

Hazardous Materials Incidents-Transportation

Definition

An uncontrolled release of hazardous materials during transport capable of posing a risk to life, health, safety, property or the environment.

Hazard Description

As a result of the extensive use of chemicals in Macomb County, especially in the automotive, metal and plastics sectors, all modes of transportation, highway, rail, air, marine, and pipeline are carrying thousands of hazardous materials shipments on a daily basis through local county communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people with a significant impact on the environment.

Macomb County has had numerous hazardous material transportation incidents that affected the immediate vicinity of an accident site or a small portion of the surrounding community. Those types of incidents, while problematic for the affected community, are fairly commonplace. They are effectively dealt with by local emergency responders and hazardous material response teams. Larger incidents, however, pose a whole new set of problems and concerns for the affected community. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material (or have the potential for such a release) can adversely impact the life safety and/or health and well-being of those in the immediate vicinity of the accident site, as well as those who come in contact with the spill or airborne plume. In addition, damage to property and the environment can be severe as well. Statistics show almost all hazardous material transportation incidents are the result of an accident or other human error. Rarely are they caused simply by mechanical failure of the carrying vessel.

Located on the Great Lakes, one of the most dangerous hazardous material transportation accident scenarios that could occur in Macomb County would be a spill or release of oil, petroleum or other harmful materials into one of the lakes from a pipeline or transportation methods. Such an incident, if it involved a large quantity of material, could cause environmental contamination of unprecedented proportions. Fortunately, Macomb County, working in partnership with oil and petroleum companies and other private industry, has taken significant steps to ensure that a spill of significant magnitude is not likely to occur that would endanger the Great Lakes. (Note: Pipeline transportation accident issues are addressed in the Petroleum and Natural Gas Pipeline Accidents section of this document. Refer to that section for information on that particular hazard.)

Significant Hazardous Material Transportation Incidents

Macomb County has experienced several large-scale serious hazardous material transportation incidents. On October 12, 1983, a tank truck overturned, spilling 5,000 gallons of methlamylketone. The spill forced the evacuation of 600 people. In Chesterfield Township, on December 28, 1982, a tanker carrying nitric acid waste began leaking, resulting in 12 injuries and forced the evacuation of 1,200 people in the surrounding area. Recently, a propane tank car fell from an overpass onto I-696 freeway. Fortunately, no injuries were reported. Also, Macomb County has had numerous smaller-scale hazardous material transportation incidents that required a response by local fire departments and hazardous material teams, and many required the implementation of evacuation and other protective actions. As a major manufacturer, user and transporter of hazardous materials, Macomb County will always be vulnerable to the threat of a serious hazardous material transportation incident.

Note: A reportable hazardous material incident is one in which all three of the following conditions apply: 1) a material is present that is suspected to be other than ordinary combustible by-product material; 2) the material is in such a state, quantity or circumstance that, if left unattended, it is presumed to pose a threat to life, health, property or the environment; and 3) special hazardous material resources were dispatched or used, or should have been dispatched or used, for assessing, mitigating or managing the situation.

Programs and Initiatives

Chemical Awareness Week

Each spring, the Emergency Management Division, Department of State Police, in conjunction with several other state agencies, Local Emergency Planning Committees (LEPCs), and the Michigan Chemical Council, sponsors Chemical Awareness Week. This annual public information campaign focuses on:

- 1) The hazards associated with the manufacture, transport, storage, use and disposal of chemicals,
- 2) The programs and systems in place to protect the public from accidental chemical releases; and
- 3) Community emergency response procedures for chemical accidents, informational materials on chemical hazards and safety are disseminated to schools, hospitals, nursing homes, other interested community groups and facilities, and the general public.

Analysis and Impact

The maps, at the end of this section, illustrate the major railroads, highways, and pipelines in Macomb County. Included also is the locations of the highest incidents of accidents which may be used as a pattern for potential accidents involving hazardous materials and a list of hazardous materials transported through Macomb County via rail lines. These transportation links and nodes have the greatest probability of experiencing a hazardous material transportation incident. Although the greatest risk involving hazardous materials comes from pipeline, highway, and rail shipments, a petroleum or chemical spill on the Great Lakes could have disastrous consequences for shoreline communities, recreational areas, tourism, and the environment.

Action Plan

The county's Office of Emergency Management will work with local community leaders to restrict the use of land and establish minimum standards to avoid hazardous sites and work with the Local Emergency Planning Committee to enhance public awareness in areas prone to hazards in the vicinity of hazardous material transportation routes.

Hazardous Materials Transported Through Macomb County Via Canadian National Railroad

Description	Class	UN/NA Number
Acetone	3	UN1090
Acrylonitrile, Inhibited	3	UN1093
Alc Bev	3	UN3065
Ammonia, Anhydrous, Liquified/Sol.	2.4	UN1005
Ammonium Nitrate Fertilizers, NOS	5.1	UN2072
Ammonium Nitrate	5.1	UN1942
Butadienes, Inhibited	2.1	UN1010
Butadienes, Inhibited,	2.1	UN1010

Butanols	3	UN1120
Butyraldehyde	3	UN1129
Carbon Dioxide, Refrigerated Liquid	2.2	UN2187
<i>Chlorine</i>	<i>2.3</i>	<i>UN1017</i>
Denatured Alcohol	3	UN1987
Dicyclopentadiene	3	UN2048
Dimethylamine, Anhydrous	2.1	UN1032
Dimethylformamide	8	UN2051
Elevated Temperature Liquid, NOS	9	UN3257
Ethanol or Ethanol Solutions	3	UN1170
Ethanol/Solutions	3	UN1170
Ethyl Acetate	3	UN1173
Ethylene Glycol	9	NA3082
<i>Ethylene Oxide</i>	<i>2.1</i>	<i>UN1040</i>
ETM, LQD, Flam	3	UN3256
Ferric Chloride Solution	8	UN2582
Ferric Sulfate Solution	8	UN1760
Ferrous Chloride, Solution	8	UN1760
Hydrochloric Acid or Solution	8	UN1789
<i>Hydrogen Fluoride, Anhydrous</i>	<i>8</i>	<i>UN1052</i>
Hydrogen Peroxide or Aque Sol.	5.1	UN2015
Isoprene & Pentene	3	UN1993
Kerosene	3	UN1223
Liquified Petroleum Gas (Butane),	2.1	UN1075
LPG (Butane)	2.1	UN1075
LPG (Propane)	2.1	UN1075
LPG (Propane/Propylene)	2.1	UN1075
LPG (Propylene) Not Odorized	2.1	UN1075
LPG (Propylene)	2.1	UN1075
LPG	2.1	UN1075
Maleic Anhydride	8	UN2215
Methylnaphthalenes,	9	UN2308
N,N-Dimethylformamide	3	UN2265
Naphtha	3	UN2553
Pet Dist, NOS	3	UN1268
Pet Dist, NOS	3	UN1268
Phenol, Molten	6.1	UN2312
Phosphoric Acid	8	UN1805
Phosphoric, Acid	4.2	UN1805
Phosphorus, White/Yellow,	4.2	UN1381
POISONOUS Liquids, NOS	6.1	UN2810
Propylene Oxide	3	UN1280
Sodium Chlorate	5.1	UN1495
<i>Sodium Cyanide</i>	<i>6.1</i>	<i>UN1689</i>
Sodium Dithionite	4.2	UN1384
Sodium Hydroxide, Solution,	8	UN1824
Sodium Phosphate, Dibasic	9	UN3077
Styrene Monomer, Inhibited	3	UN2055
Sulfur, Molten	9	UN2448
<i>Sulphur Dioxide</i>	<i>2.3</i>	<i>UN1079</i>
Sulphur, Molten,	4.1	UN2448

Sulphuric Acid	8	UN1830
<i>Sulphuric Acid, Fuming</i>	<i>8</i>	<i>UN1831</i>
Sulphuric Acid, Spent,	8	UN1832
Tripropylene	3	UN2057
Vinyl Acetate, Inhibited	3	UN1301
Waste Corrosive Liquids, NOS	8	UN1760
Waste Sulphur Acid, Spent	8	UN1832
White Asbestos	9.1	UN2590
Xylenes,	3	UN1307

Italicized indicates special evacuation distances.

Infrastructure Failure

Definition

The failure of critical public or private utility infrastructure resulting in a temporary loss of essential functions and/or services.

Hazard Description

Macomb County's citizens and businesses are dependent on the public and private utility infrastructure to provide essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of these independent, yet interrelated systems fail due to disaster or other cause, even for a short period of time, it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can literally die in their homes if immediate mitigative action is not taken (Extreme Temperature Section). When the water or wastewater treatment systems in a community are inoperable, serious public health problems arise that must be addressed immediately to prevent outbreaks of disease (Public Health Emergencies Section). When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur (Riverine/Urban Flooding).

These are just some examples of the types of infrastructure failures that can occur, and all of these situations can lead to disastrous public health and safety consequences if immediate mitigative actions are not taken. Typically, it is the most vulnerable members of society (i.e., the elderly, children, impoverished individuals, and people in poor health) that are the most heavily impacted by an infrastructure failure. If the failure involves more than one system, or is large enough in scope and magnitude, whole communities and possibly even regions can be severely impacted (Dam Failures and Petroleum and Natural Gas Pipeline Accidents).

Significant Infrastructure Failures

Unfortunately, Macomb County has had its share of infrastructure failures, mostly due to the effects of natural disasters such as snow and ice storms, severe cold, windstorms, tornadoes and floods.

In 1978, and again in 1980, a large sewer main that served nearly 300,000 residential and business users in northern Macomb and Oakland Counties partially collapsed. The collapses were of such magnitude that continued sewer service to the 300,000 users was in peril. Fortunately, officials were able to install temporary sleeves within the damaged main until it could be properly repaired. However, in order to relieve the backpressure and keep basements from filling with sewage, officials were forced to divert millions of gallons of raw sewage into the Clinton River, fouling miles of Lake St. Clair beaches. Eventually, the damaged sections of sewer main were repaired, but this unfortunate incident caused tremendous disruption and environmental damage to the area. It showed how serious a large-scale sewer infrastructure failure in a densely populated area could be.

Programs and Initiatives

Water Distribution Systems

Macomb County's "public" water supplies are regulated under the Federal Safe Drinking Water Act. The Michigan Department of Environmental Quality (MDEQ), as a primary agency for the Federal government, provides supervision and control of Michigan's public water supplies (including their operation and physical improvements) under the Michigan Safe Drinking Water Act (399 P.A. 1976).

The MDEQ Drinking Water and Radiological Protection Division regulates, through a permit process, the design, construction and alteration of a public water supply system. Water supply construction must be conducted within the framework of the Michigan Safe Drinking Water Act, as well as the Architecture, Professional Engineering and Land Surveying Act (240 P.A. 1937, which requires professional engineering preparation of construction documents for water works construction costing over \$15,000). Communities in Macomb County have, in conjunction with the MDEQ, developed water system master plans that conform to the requirements of the Michigan Safe Drinking Water Act. From a hazard mitigation standpoint, that is important because it helps ensure that all new water system construction and alterations to existing systems will conform to the minimum standards set in the Act. While not making water infrastructure "disaster-proof", the standards provide at least a basic level of design, structural and operational integrity to new or renovated portions of a community's water supply system. Also, many communities in Macomb County are cross connecting to each other in the event of a water supply failure.

Wastewater Collection/Treatment Systems

The Federal Clean Water Act regulates the discharge from community wastewater collection and treatment systems. The regulatory aspects of the Act that pertain to municipalities have been delegated to the MDEQ Surface Water Quality Division for surface water discharge facilities, and the MDEQ Waste Management Division for groundwater discharge facilities. Authority for the oversight of planning, facility design review, and construction permitting of sewerage systems collection, transportation and treatment facilities, is derived from Part 41 of the Michigan Natural Resources and Environmental Protection Act (451 P.A.-1994) and Administrative Rules promulgated under authority of Part 41. The two MDEQ divisions assist communities with the development and maintenance of their wastewater collection and treatment systems. In addition, they monitor and regulate these systems to ensure pollution abatement and health conditions are met. Although the regulatory authority vested in the MDEQ is primarily aimed at preventing pollution of waters of the state, there are requirements in place under 451 P.A. 1994 regarding the design, construction, and operational integrity and reliability of wastewater collection and treatment systems.

The U.S. Environmental Protection Agency's (EPA) Technology Transfer Program, the "Recommended Standards for Sewage Works" developed by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, and other technical references provide important technical information to MDEQ personnel about the design and operation of wastewater collection and treatment system components. This information is used extensively by the MDEQ to review designs and operation procedures for the municipal wastewater program. Included within this guidance are basic minimum standards that help ensure an adequate level of structural and operational integrity for wastewater systems.

Surface Drainage Systems

Michigan's first drain laws appeared on the books as Territorial laws, years before Michigan achieved statehood. After attaining statehood in 1837, the State passed its first drain law in 1839. Since that time, there have been 45 separate acts passed regarding drainage, up to the most recent re-codification of drain law in 1956. Since 1956, the present drain code has been amended over 200 times, an indication of how important and dynamic the issue of drainage continues to be in Michigan.

The Michigan Drain Code provides for the maintenance and improvement of the vast system of intra-county (county) and inter-county drainage facilities. Each drain has a corresponding special assessment district (watershed), a defined route and course, an established length, and is conferred the status of a public corporation with powers of taxation, condemnation, ability to contract, hold, manage and dispose of property, and to sue and be sued. Drainage districts and drains are established by petition of the affected landowners and/or municipalities. County drains, with a special assessment district entirely within the county, are administered by the locally elected County Drain Commissioner. Inter-county drains, with a special assessment district in more than one

county, are administered by a drainage board that consists of the drain commissioners of the affected counties, and is chaired by the Director of the Michigan Department of Agriculture (MDA) or an MDA Deputy Director.

The intra-county and inter-county drainage program administered by county drain commissioners and the MDA operates, maintains, and improves water conveyance and treatment systems ranging from small agricultural drains to urban storm drains and/or sanitary drains. (Note: Some drains are constructed of pipes that range in size from 12 inches in diameter to over 16 feet in diameter, with massive pumping stations carrying storm and/or sanitary sewage which serve thousand of residents. Other drains are open channels or ditches that vary from several feet in width and dry during part of the year, to large river channels in excess of 100 feet in width. Flood water retarding dams, flood pumps, erosion control structures, storage basins and wastewater treatment structures are also part of the infrastructure constructed under the Michigan Drain Code.) Statewide, there are over 18,000 established drainage districts with an estimated combined length of over 40,000 miles of channel. These facilities vary from rural agricultural open channels with drainage areas of several hundred acres to large river systems with drainage areas of several hundred square miles.

As Michigan's villages, towns and cities have grown, the drains that were designed to serve primarily agriculture have also been used to carry storm water from municipalities and subdivisions, as well as serve as outlets for sanitary treatment plants and a variety of other permitted discharges. Operation, maintenance, and improvement of drains in suburban and urban areas now provides for the management of storm water combined sanitary overflows, and sanitary sewage collection and treatment. Increasing demands on the drainage system in many areas of the State requires that continuous improvements be made to enhance drain capacity and flow characteristics, reduce sedimentation, and improve structural integrity.

Electrical Systems

Disaster-related damage to electric power facilities and systems is a concern that is being actively addressed by utility companies across the state. Detroit Edison, Macomb County's supplier of electricity, has an active, ongoing program to improve system reliability and protect facilities from damage by wind, snow and ice, and other hazards. Typically, the focus of the program is on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting equipment from lightning strikes, and placing new distribution systems underground. The Michigan Public Service Commission (MPSC) monitors power system reliability to help minimize the scope and duration of power outages.

Telecommunications Systems

Like electric utility companies, telecommunications companies are concerned with the issue of protecting facilities and systems from disaster-related damage. Major telecommunications companies have programs to improve system reliability and physically protect facilities and system components from wind, snow and ice, and other hazards, utilizing many of the same techniques as the electric utility companies.

Analysis and Impact

Although Michigan has in place many codes and standards that govern the design, construction and operation of public and private utility infrastructure, these codes and standards are often inadequate to protect the infrastructure from disaster-related damage. In many cases, the codes and standards call for the minimum level of structural integrity and operational performance recommended in standard engineering practice, when a higher level would result in less natural disaster damage. Obviously, a balance must be reached between structural integrity, operational reliability, and short and long-term costs associated with upgrading facility codes and standards.

It is possible to design and operate facilities that are virtually "disaster-proof". However, in many cases it is not economically feasible to do that. Often, the ratio of increases in structural integrity and operational reliability to the costs of obtaining that level of performance is prohibitive.

Small incremental increases in integrity and reliability can result in exponential increases in cost. In some cases, it may be too expensive to upgrade infrastructure codes and standards beyond current levels. However, in those cases where recurring, severe damage and system down-time occur due to natural hazard events, it makes sense to explore the possibility of enhancing infrastructure design, construction and operational codes and standards. The State of Michigan, in concert with public and private utility providers, is in the beginning phases of doing that through its statewide hazard mitigation efforts.

As Macomb County's public and private utility infrastructure systems begin to age, infrastructure disasters will undoubtedly become more common. Because many of these systems were developed decades ago, the costs of repairing and replacing aging sections/components has greatly increased. As a result, many communities cannot afford to do the maintenance work necessary to keep the system in ideal operational mode. Increasing demands on the system also lead to increased deterioration. This creates a formula for increasing numbers of infrastructure-related disasters, either as a primary event, or as a secondary event to floods, windstorms, snow and ice storms, etc. When those disasters do occur, they cause great inconvenience to the affected population and they can also create severe public health and safety concerns.

Macomb County is a highly developed region. As such, it is highly dependent on public and private utility systems for the provision of essential life-supporting services, for the movement of people and goods and for communications and the transmission of information. As a result, the possibility of infrastructure failure must be addressed in every County community through wise system design and community development practices, and through prudent emergency preparedness that takes into account the issues and needs specific to infrastructure failures. In addition, the State of Michigan needs to continue to push for greater system reliability through its continuing long-term infrastructure hazard mitigation program.

Although the problem of infrastructure failure will never be completely eliminated, it can certainly be greatly diminished through proper planning, design, construction and maintenance practices.

Action Plan

The Office of Emergency Management will work with the public utilities to reduce the effects of natural and technological hazards upon the county's infrastructure. Emphasis should be placed on tree trimming programs and identification of underground systems.

Nuclear Attack

Definition

Any large-scale hostile action taken against the United States which involves nuclear weapons and results in destruction of military and/or civilian targets.

Hazard Description

World events in recent years have greatly changed the nature of the nuclear attack threat against the United States. The breakup of and establishment of democratic forms of government in the former Soviet Union and other Soviet-Bloc nations in Eastern Europe has essentially ended the "Cold War" that shaped and influenced world politics since the late 1940s'. That tremendous turn of events has, for all intents and purposes, reduced the need for the United States and former Soviet states to maintain huge stockpiles of nuclear weapons. The reduction in nuclear weapons stockpiles that has occurred over the past few years in both countries has diminished the threat of a full-scale, massive nuclear attack that would threaten the very existence of the world as we know it.

However, while the threat of attack is diminished, it is still a possibility due to the large number of nuclear weapons still in existence in present-day Russia and throughout the rest of the world. Even though an International Nuclear Non-Proliferation Treaty is in place, several countries are thought to be actively pursuing the development of nuclear weapons. In addition, internal instability and strife within Russia and some of its neighboring countries could cause the region to fall back under its previous form of government, which could potentially revive a larger-scale nuclear attack threat. Both Russian and U.S. nuclear weapons systems remain on high alert, which increases the risk of an accidental nuclear launch that could spawn a nuclear counter-attack. Given the state of Russia's aging nuclear technical systems, that scenario is not out of the realm of possibility. Although the nature and scope of an attack at this time would likely be reduced from previous possibilities, the potential impact on the country would still be devastating.

Despite the fact that it is based on a fully armed and functional Soviet Union as an adversary, Federal Emergency Management Agency (FEMA) attack planning guidance provided in the document Nuclear Attack Planning Base 1990 (NAPB-90) remains the basis for the population protection strategy adopted for Michigan. This strategy is incorporated in the Michigan Emergency Management Plan (MEMP) and the Macomb County Emergency Action Guidelines (EAGs). The NAPB report identifies potential aiming points or target areas throughout the United States. Macomb County has three potential targets within its borders with two targets to the north (St. Clair County) and two potential targets to the south (Wayne County).

Programs and Initiatives

In response to the threat of nuclear attack, FEMA has in the past advocated a population protection strategy using a combination of evacuation and in-place sheltering. In Macomb County, evacuation areas have been determined for the 3 target areas within the county. These areas are called Planned Evacuation Areas (Map of Planned Evacuation Areas is enclosed). The population within these areas is to evacuate to Close-in or General Shelter Areas. Residents in the Close-in and General Shelter Areas would seek protection in designated shelters or home basements.

This population protection concept makes maximum use of the best available shelter space and presents a reasonable and manageable evacuation area. Evacuation can be accomplished in a relatively short period of time.

Action Plan

The map on the following page indicates the locations of the designated attack target areas in Macomb County. Although the nature and scope of the attack threat against the United States has changed significantly, there is still a possibility that a nuclear attack could still occur given the

right set of world circumstances. A full-scale attack in the foreseeable future is not likely; however, a limited attack could take place that could potentially threaten Macomb County target areas. Given the tremendous destructive capability of even one nuclear weapon, the devastation that could occur would be far worse than anything ever experienced in this country. For that reason, it makes sense to continue to prepare for the nuclear attack hazard as part of an overall emergency management strategy.

Nuclear Power Plant Accidents

Definition

An actual or potential release of radioactive material at a commercial nuclear power plant or other nuclear facility, in sufficient quantity to constitute a threat to the health and safety of the off-site population.

Hazard Description

Though the construction and operation of nuclear power plants are closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents at these plants are considered a possibility and appropriate on-site and off-site emergency planning is conducted. An accident could result in the release of potentially dangerous levels of radioactive materials into the environment that could affect the health and safety of the public living near the nuclear power plant. A nuclear power plant accident might involve both a release of air borne radioactive materials and radioactive contaminate of the environment around the plant. The degree and area of environmental contamination could vary greatly depending on the type and amount of radioactivity and weather conditions. Response to a nuclear power plant accident requires specialized personnel who have been trained to handle radioactive materials safely, who have specialized equipment to detect and monitor radiation, and who are trained in personal radiation exposure control.

Significant Nuclear Power Plant Accidents

Fortunately, Macomb County does not have a nuclear power plant within its borders. However, with a commercial nuclear power plant operating nearby (the Enrico Fermi-2 plant near Monroe), emergency preparedness is required.

Response to a nuclear power plant accident in Michigan is the joint responsibility of the plant owner/operator and federal, state, and local government. State and local government implement protective actions and other preparedness and response activities based on the Nuclear Accident Emergency Action Level Classification System. In most cases, the Primary Emergency Planning Zone (EPZ) around a nuclear power plant is 10 miles. Within this zone, plans are developed to protect the public through in-place sheltering and evacuation, in the event of an accident. The area within the Primary EPZ for which protective actions are implemented will depend on the type and amount of radioactive material released and weather factors. The Secondary Emergency Planning Zone, consisting of a 50-mile radius around most plants, exists for planning considerations which prevent the introduction of radioactive contamination into the food chain. In Macomb County, this will include the communities of Warren, Center Line, Sterling Heights, Roseville, and St. Clair Shores, Eastpointe, and Fraser.

Analysis and Impact

Federal, state, local governments, and utility personnel (Detroit Edison) take extensive precautions to ensure that, should a nuclear accident occur, its impact on the safety and well being of the general public and the environment will be minimal. These precautions include development and continual testing of emergency plans, training of response personnel, coordination of response actions, and development and dissemination of emergency public information.

Action Plan

As Macomb County is within the Secondary Planning Zone (Enrico Fermi-2), a review, coordinated with the County Public Health Department, of the County's Emergency Response Plan should be done on an annual basis to ensure that information and the emergency response is adequate. This information should be shared with the communities affected by a nuclear accident.

Petroleum and Natural Gas Pipelines

Definition

An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline.

Hazard Description

Though often overlooked, petroleum and natural gas pipelines pose a real threat in many Michigan communities. Petroleum and natural gas pipelines can leak or erupt and cause property damage, environmental contamination, injuries, and even loss of life. The vast majority of pipeline accidents that occur in Michigan are caused by third party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations.

Macomb County is both a major consumer and producer of natural gas and petroleum products. Vast quantities of petroleum and natural gas are extracted from, transported through, and stored in the county, making many areas vulnerable to petroleum and natural gas emergencies. Macomb County's gas and petroleum networks are highly developed and extensive, representing every sector of the two industries, from wells and production facilities, to cross-country transmission pipelines that bring the products to market, to storage facilities, and finally to local distribution systems.

The County's Office of Emergency Management and representatives from the pipeline companies have worked together for many years sharing information and data. While it is true, that the petroleum and natural gas industries have historically had a fine safety record, and that pipelines are by far the safest form of transportation for these products, the threat of fires, explosions, ruptures, and spills nevertheless exists. In addition to these hazards, there is the danger of hydrogen sulfide (H₂S) release. These dangers (fully explained in the Oil and Natural Gas Well Accidents section) can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has a high sulfur content. Hydrogen sulfide is not only an extremely poisonous gas, but is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above.

Significant Petroleum and Natural Gas Pipeline Accidents

Petroleum and natural gas pipeline accidents occur with some regularity, but they usually have a limited impact and are quickly and adequately handled by pipeline company emergency crews and local and state responders. While it is true that Macomb County has been free of catastrophic pipeline accidents, the possibility is always there for a significant accident to occur. Macomb County is traversed by several major petroleum and natural gas pipelines. Two of the high-pressure natural gas pipelines are located in urban areas. The pipelines could rupture at any time, resulting in severe explosion and fire, property damage, environmental contamination, and possible injuries or loss of life.

Programs and Initiatives

Pipeline jurisdiction and oversight in Michigan is complex, determined primarily by the type and function of a pipeline and its location. Agencies involved include: 1) the MPSC Gas Safety Office; 2) the USDOT/OPS in Kansas City, Missouri; and 3) the Michigan Department of Environmental Quality, Geological Survey Division (NIDEQ/GSD).

The issue of gathering line jurisdiction is even more complex. Gathering lines in non-rural areas fall under the jurisdiction of the Michigan Gas Safety Code. Gathering lines that serve as common carriers fall under the jurisdiction of the MPSC, but may not necessarily fall under the Michigan Gas Safety Code. All other gathering lines fall under the jurisdiction of the MDEQ/GSD.

Following are the major programs and initiatives in place to help ensure petroleum and natural gas pipeline safety in Michigan:

Michigan Gas Safety Code

Pipeline operators are regulated under the Michigan Gas Safety Code, 165 P.A. 1969, and its implementing Administrative Rules, to ensure public safety is protected to the extent possible in the transportation of gas by pipeline. Under the Code, which is administered by the MPSC, gas pipeline companies (operators) must develop and maintain written procedures to minimize the hazard resulting from a gas pipeline emergency. The procedures must provide for the following:

- 1) Identification and classification of events;
- 2) Notification of and communication with local response agencies and public officials;
- 3) Response to all types of gas emergencies, including emergency shutdown and pressure reduction procedures;
- 4) Coordination of response actions with the local jurisdiction(s);
- 5) Restoration of service.

Operators must also ensure that personnel are properly trained and knowledgeable of emergency procedures. If an incident occurs, the operator must review response actions to determine if procedures were followed, and if necessary, take samples of the failed facility or equipment for laboratory examination to determine the cause of the failure. Mitigative actions are taken as necessary to minimize the possibility of a recurrence.

MPSC Pipeline Safety Inspections

Safety engineers from the MPSC are certified by the USDOT/OPS to conduct inspections on gas and petroleum pipelines to ensure structural and operational integrity of the systems. If violations are found, the pipeline company can be ordered to take corrective actions, fined, or both. The MPSC safety engineers also respond to accidents involving natural gas or petroleum pipelines (to ensure compliance with federal and state law and to offer technical assistance to emergency responders).

U.S. Department of Transportation, Office of Pipeline Safety

Additional pipeline safety requirements are contained in the Federal Safety Standards (Parts 193 and 195), as administered by the USDOT/OPS. Pipeline operators must develop and maintain written emergency procedures similar to those required under the Michigan Gas Safety Code. In addition, they are required to coordinate both planned and actual response actions with local officials and response agencies. Part 195 also has a continuing education requirement to keep local officials and the general public informed about the risks associated with the transportation of hazardous liquids via pipeline.

National Transportation Safety Board

The National Transportation Safety Board (NTSB) investigates all significant pipeline accidents that occur and issues safety recommendations, for the pipeline company and government regulators, aimed at preventing future accidents. The NTSB also publishes a list of "most wanted" safety improvements for pipelines and other modes of transportation for nationwide implementation by appropriate entities. Although these safety improvement recommendations are not mandatory, and the NTSB has no regulatory or enforcement powers, it nonetheless has been successful in getting more than 80% of its recommendations adopted. Many safety features currently incorporated into pipelines and other transportation modes had their genesis in NTSB recommendations.

Local Emergency Action Guidelines

Communities that may be affected by petroleum or natural gas emergencies should have adequate procedures in their Emergency Action Guidelines to address the unique types of problems associated with this hazard, including specific functions such as rescue and evacuation. Affected communities must work closely with company officials and surrounding jurisdictions to ensure a fast, coordinated response. Mitigation possibilities include the use of community zoning regulations to

provide suitable open, unoccupied "buffer" areas around pipelines, storage fields, refineries, and compressor stations.

Analysis and Impact

Major compressor stations that receive and redistribute natural gas are located at key points along the pipelines. These stations monitor and maintain pressure levels within the pipelines. In the event of a pipeline rupture, the compressor stations shut down to stop the flow of product. Many smaller compressor stations are located across the county to complete the distribution process to consumers.

The major natural gas storage facilities are located in the central part of the County. Natural gas is piped into those storage facilities from Michigan wells, and from large transmission pipelines that originate in Western Canada and the east coast of the U.S.

Petroleum pipelines carry crude oil, fuel oil, propane, butane, gasoline and other petroleum products. Many of the refineries, terminals, and storage areas are located in the St. Clair County/Sarnia, Canada region where the potential for extensive damage and threat to lives and property is greatest.

Action Plan

Based on information supplied, petroleum and natural gas pipeline accidents are an inevitable occurrence. Affected local communities must be prepared to respond to the accident, institute necessary protective actions, and coordinate with federal and state officials and the pipeline company emergency crews to effectively manage and recover from the accident. That can best be accomplished through collaborative planning, training, and exercising of emergency procedures with all potentially involved parties. The Office of Emergency Management should identify the location of pipelines in Macomb County and develop a county-wide plan that will enable local response teams to respond in a safe and effective manner. This county-wide plan should be incorporated into the county's Emergency Action Guidelines. This project should be assigned to the Assistant Emergency Management Coordinator.

Oil and Gas Well Accidents

Definition

An uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells.

Hazard Description

Oil and natural gas are produced from fields scattered in north and central Macomb County. At the time of this study there were 681 gas and oil wells located in Macomb County. Underground gas storage fields in Macomb County are located in Lenox, Richmond, Ray, and Washington Townships. The petroleum and natural gas industry is highly regulated and has a fine safety record, but the threat of accidental releases, fires and explosions still exists. In addition to these hazards, many of Macomb County's oil and gas wells contain extremely poisonous hydrogen sulfide (H₂S) gas. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in the oil or brine and released upon exposure to atmospheric conditions.

Although hydrogen sulfide can be detected by a "rotten egg" odor in concentrations from .03 ppm. to 150 ppm., larger concentrations paralyze a person's olfactory nerves so that odor is no longer an indicator of the hazard. Within humans, small concentrations can cause coughing, nausea, severe headaches, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulfide forms explosive mixtures with air at temperatures of 500 degrees Fahrenheit or above, and is dangerously reactive with powerful oxidizing materials. Hydrogen sulfide can also cause the failure of high-strength steels and other metals. This requires that all company and government responders be familiar not only with emergency procedures for the well site, but also with the kinds of materials that are safe for use in sour gas well response.

Significant Oil and Natural Gas Well Accidents

To date, Michigan has been fortunate not to have an oil or natural gas well accident that resulted in loss of life or significant property damage. However, several recent, significant oil and natural gas well accidents have occurred that required an emergency response by the drilling company and state and local officials.

Contingency Plans

Contingency plans for public protection are required for wells at which the 100 ppm. of H₂S RoE (Radius of Exposure) is greater than 100 feet. The plans are divided into two parts. Part I contains general procedures that must be implemented by company personnel in an emergency when H₂S is released. This includes emergency contacts and their assigned duties and responsibilities, notification and evacuation procedures for the general public, and procedures for igniting the well. Part II contains site-specific information and must be filed with the application for a drilling permit. Well owners have the option of working with the local Emergency Management Coordinator instead of preparing a required site map and list of residences. This option can be used in highly populated areas. Other H₂S administrative rules address special equipment requirements for drilling, testing and production of H₂S-bearing wells. The rules are intended to provide for public protection and nuisance odor mitigation.

Analysis and Impact

Over the years, Michigan has experienced periodic upward and downward trends in oil and natural gas production as new reservoirs were discovered and older ones became depleted. Macomb County reaps tremendous economic and social benefits from oil and natural gas production. As with all industrial and commercial activities, along with those benefits come some risks as well. Despite the best efforts of the MDEQ Geological Survey Division and the drilling

companies to minimize oil and natural gas well accidents, it is inevitable that such accidents will occur from time to time. When they do, the affected local communities must be prepared to respond to the accident, institute necessary protective actions, and coordinate with state officials and the drilling company emergency crews to effectively manage and recover from the accident. That can best be accomplished through collaborative planning, training, and exercising of emergency procedures with all potentially involved parties.

Action Plan

Communities that may be affected by oil or natural gas well accidents should have adequate procedures in their Emergency Action Guidelines to address the unique types of problems associated with this hazard, including rescue and evacuation. Affected communities must work closely with company officials and surrounding jurisdictions to ensure compatibility of procedures for a fast, coordinated response. Mitigation possibilities include the use of community zoning regulations to provide suitable open, unoccupied "buffer" areas around refineries and compressor stations. Michigan Department of Environmental Quality regulations provide for buffer zones around wells and treatment and storage facilities. The Office of Emergency Management should help local emergency officials identify the location of wells within their communities and develop a county-wide response plan to mitigate hazards. This response plan should be incorporated into the county's Emergency Action Guidelines (EAG). This project should be assigned to the Assistant Emergency Management Coordinator.

Public Health Emergencies

Definition

A widespread and/or severe epidemic, incident of contamination or other situation that presents a danger to or otherwise negatively impacts the general health and well being of the public.

Hazard Description

Public health emergencies can take many forms, disease epidemics, large scale incidents of food or water contamination, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, and large scale infestations of disease carrying insects or rodents, to name just a few. Public health emergencies can occur as primary events by themselves, or they may be secondary events to another disaster or emergency such as a flood, tornado, or hazardous material incident. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be statewide, regional, or localized in scope and magnitude.

Perhaps the greatest emerging public health hazard would be the intentional release of a radiological, chemical or biological agent to adversely impact a large number of people. Such a release would most likely be an act of sabotage aimed at the government or a specific organization or segment of the population. Fortunately, to date, Macomb County has not yet experienced such a release aimed at mass destruction.

Loss of Water/Sewer Service

A breakdown of critical water and sewer infrastructure can (if not immediately abated) result in a public health emergency for the affected area. That is exactly what happened in Oakland County in 1999. Due to a water main break, boil-water advisories were issued in many communities due to the potential for water contamination from lack of adequate system pressure. Fire safety hazards were also prevalent due to the lack of adequate system pressure.

Macomb County is fortunate in that it has an excellent public health system and a professional management team that constantly monitors the threats that could lead to a widespread or significant public health emergency. However, even the best monitoring and surveillance programs cannot always prevent such incidents from occurring. If an emergency does occur, Macomb County's Public Health Department has shown the ability to effectively muster the resources necessary to identify and isolate the problem and mitigate its effects on the population. In addition, if the problem is such that a multi-agency and jurisdictional response is required, the emergency management system in Michigan can be utilized to enhance coordination and effectiveness of the response and recovery effort.

Action Plan

The Office of Emergency Management, in partnership with the county's Public Health Department, shall identify potential problems that may affect the county. A hospital subcommittee should be established within the Local Emergency Planning Committee to facilitate the planning for large-scale disasters.

Sabotage/Terrorism

Definition

An intentional, unlawful use of force, violence or subversion against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political, social, or religious objectives.

Problem Statement -Terrorist Vulnerability

There are many factors that make Macomb County ideal for a terrorist attack:

- Two key military installations, Selfridge A.N.G. Base and the U.S. Army Tank Command.
- Easy international access from Canada via bridges, tunnels, ferries, and ships and boats. Large foreign freighters use the Great Lakes waterways. This area has experienced difficulties from ships releasing foreign substances into the environment (i.e. zebra mussels).
- Industrial and commercial complexes which conduct business on a global level.
- Engineering and Design Centers such as the General Motors Tech. Center, General Dynamics Land Division, and the U.S. Army Tank Command.
- Significant ethnic population base and work force.
- Large infrastructure base for gas, oil, electric, water supply, highways, waterways, railways, hospitals and medical treatment centers proximity to Detroit.
- Utilities such as water, electricity, and gas could be affected by terrorist attacks from outside of Macomb County.
- Key government and public facilities - office buildings of governmental units along with corporations with government contracts, police, fire, and EMS units, water treatment facilities, post offices, churches, and schools.

It is a well-known fact that the metropolitan Detroit area, with its automotive facilities, is known as the Motor Capital of the world. Along with that distinction, comes industrial and manufacturing power as seen during the historical period of World War II, where it was known as the "Arsenal for Democracy". That makes this area a prime target for a terrorist attack. Third world countries cannot compete with the military power and technology of the United States. However, we can be severely crippled by a Weapons of Mass Destruction incident involving nuclear, biological, and chemical (NBC) agents. They (Weapons of Mass Destruction) can be easily transported and activated without detection, and would cause massive pain, suffering, and fatalities.

Problem Statement - Needs Assessment

An assessment of the current capability of Macomb County to respond to and mitigate a terrorist incident has been completed, with the cooperation of the Macomb County Fire Chiefs Association, Macomb County Chiefs of Police Association, the Macomb County Sheriff Department, and the Macomb County Medical Control Board. Upon evaluation, Macomb County has sufficient resources to respond to and mitigate most emergencies involving police, fire, emergency medical service (EMS).

At the present, there are three response teams that can handle a Weapons of Mass Destruction Incident within Macomb County. These three response teams provide

response coverage for their immediate jurisdictions, and through mutual aid agreements, cover the remainder of the county as a whole. It is recommended that equipment and training be provided throughout the county to advance local first response capability to Tier Three (Technicians Capability Level).

Overview of the County's Capability

A law enforcement community of nineteen (19) police departments, the Macomb County Sheriff, the Michigan State Police, a Michigan State Police Crime Laboratory, and a Federal Bureau of Investigation Field Office service Macomb County. All sworn police officers have completed the mandatory curricula established by the Michigan Law Enforcement Officers Training Center.

The Macomb County Sheriff has an organized Tactical Response Team (TRT). This team is trained in sniper/counter-sniper tactics, high-risk entries/raids and hostage resistant techniques. Training includes use of chemical munitions (CSCN and pepper gas). This unit has duties of first response to major criminal incidents and suspected terrorist activities.

The response capability of this law enforcement unit meets or exceeds Tier One (baseline capability level) and Tier Two (Haz-Mat Operations Capability Level) established for law enforcement officers operating in a contaminated atmosphere.

There are six (6) additional police departments in Macomb County that perform a similar function as a Tactical Response Team. They are usually referred to as SWAT (Special Weapons and Tactics) or PERT (Police Emergency Response Team).

In the event of a major terrorist incident in Macomb County, the police departments would provide mutual aid to each other, as requested, to assist the host agency. In the event of mutual-aid, the Sheriffs' Tactical Response Team, would be the coordinating agency under the Incident Command System (ICS).

Presently, there are no law enforcement units operating in Macomb County that meet the requirements of Tier Three (Technicians Capability Level). Operational units lack analytical instruments to monitor nuclear biological and chemical effects produced by Weapons of Mass Destruction. Presently, law enforcement depends upon the local fire departments to provide Haz-Mat responders to perform tasks requiring PPE, site monitoring, analysis, and decontamination. Communications equipment does not provide multi-jurisdictional, inter-operability and is not designed as intrinsically safe in hazardous atmospheres.

Twenty-six (26) of Macomb County's twenty-seven (27) local jurisdictions operate organized fire departments. Personnel training and equipment are controlled by regulations promulgated and enforced by the Michigan State Firefighters Training Council (FFTC) and the Michigan Occupational Safety and Health Administration (MIOSHA). All fire departments in Macomb County are part of a county wide mutual-aid pact, which provides for the ability to assist each other for fire and disaster emergencies.

Haz-Mat response is an integral part of all fire departments. All twenty-six (26) fire departments meet or exceed Tier One (Baseline Capability level) and Tier Two (Haz-Mat Operations Capability) levels. All fire departments provide the basic awareness and operations level response capability, but must look for assistance for tactical operations to control and recover from most Haz-Mat incidents.

Three Haz-Mat teams exist that are trained and equipped in compliance with 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER)

standards. These three teams are SMIRT (South Macomb Incident Response Team), Clinton Township Fire Department Special Operations Team (SOT), and Sterling Heights Fire Haz Mat Response Team.

SMIRT consists of a joint agreement between five (5) fire departments that service three communities in Macomb County. Their primary goal is to offer expertise in a Haz-Mat incident for its member communities by providing trained technicians, equipment, and a set of Standard Operation Guidelines for procedural operations at the scene of an incident. They can provide response capability for Level III and Level IV incidents. The member departments have a total of 36 Haz-Mat technicians, 10 Haz-Mat specialists, and 6 Incident Commanders (IC). Over 15 years they have acquired an extensive amount of equipment.

The Clinton Township Fire Department SOT can provide Tier Three (Technicians Level) response capability. In 1990, they formed a Hazardous Response Team. At present, they have an authorized strength of 24 personnel, 21 Haz-Mat technicians, 2 Haz-Mat specialists, a certified IC, and a certified Professional Emergency Manager (PEM), in a 70 man career department. In addition to Haz-Mat training, members also undergo training in Weapons of Mass Destruction, urban search and rescue, terrorism, and NBC response. In 1996, their Haz-Mat Response Team was reorganized as a Special Operations Team. They currently have in excess of \$498,000 in equipment. Their technicians can monitor for various atmospheric conditions including explosive gases, oxygen levels, toxic gases, chlorinated compounds, and radiation levels. On board HAZMAT kits can categorize various liquid and solid materials. Computers, Thermal Imaging Cameras, chemical databases, fax, copier and scanner capabilities are carried on board. The Clinton Township Special Operations Team provides service for its own jurisdiction, the City of Fraser and others as requested.

The Sterling Heights Fire Department completed development of their team on 09/24/99 for 24 firefighters as Haz Mat Technicians. They also have one Haz Mat Specialist and one Professional Emergency Manager(PEM). They have an extensive compliment of existing equipment and have recently received new equipment to supplement their needs.

At the present time the Township of Shelby is working with fire departments in the northern part of Macomb County to develop a regional hazardous material response team. Additional equipment and training needs have been identified to complete their goals and objectives.

The EMS serving Macomb County is also an aggregate of Fire Department operations, providing Medical First Responder, Basic Life Support and Advanced Life Support Units. There are three (3) private ambulance firms providing Advanced Life Support serving Macomb County.

Michigan Public Act 179 of 1990, as amended regulates the operation of these units. The Macomb County Medical Control Board provides local administrative, oversight and regulatory control. Protocols are promulgated by the Medical Control Board which meet or exceed standards of training and equipment established by Michigan P.A. 179.

EMS units operating in Macomb County meet or exceed Tier One (Baseline Capability Level). There are no Tier Two (Haz-Mat Operations Capability Level) EMS units operating in Macomb County. Individual units lack PPE, analytical monitoring equipment, intrinsically safe, interoperable communications and decontamination equipment.

Action Plan

It is the goal of Macomb County to provide a network of Haz-Mat Teams and Weapons of Mass Destruction Strike Teams that will be able to effectively handle

hazardous materials incidents and terrorist attacks. Objectives would include the purchasing of response equipment, training for hazardous material response, and Incident Command (IC) training for fire departments, law enforcement agencies, emergency managers and emergency medical response personnel. Training should be in accordance with federal and state guidelines, coordinated by Macomb Community College, and incorporated into their fire and police academies to ensure continuity of training and information. Cooperation between the county's Public Health and the Emergency Management Departments should proceed along the same lines as for Public Health Emergencies. This project should be assigned to the county's Emergency Management Coordinator.

Subsidence

Definition

The lowering or collapse of the land surface caused by natural or human-induced activities that erode or remove subsurface support.

Hazard Description

Subsidence is the lowering or collapse of the land surface due to loss of subsurface support. It can be caused by a variety of natural or human-induced activities. Natural subsidence occurs when the ground collapses into underground cavities produced by the solution of limestone or other soluble materials by groundwater. Human-induced subsidence is caused principally by groundwater withdrawal, drainage of organic soils, and underground mining. In the United States, these activities have caused nearly 17,000 square miles of surface subsidence, with groundwater withdrawal (10,000 square miles of subsidence) being the primary culprit. In addition, approximately 18% of the United States land surface is underlain by cavernous limestone marble, making the surface of these areas susceptible to collapse into sinkholes. Generally, subsidence poses a greater risk to property than to life.

Mine Subsidence

In Michigan, the primary cause of subsidence is underground mining. Although mine subsidence is not as significant a hazard in Michigan as in other parts of the country, many areas in Michigan are potentially vulnerable to mine subsidence hazards. Mine subsidence is a geologic hazard that can strike with little or no warning and can result in very costly damage. Mine subsidence occurs when the ground surface collapses into underground mined areas. In addition, the collapse of improperly stabilized mine openings is also a form of subsidence. About the only good thing about mine subsidence is that it generally affects very few people, unlike other natural hazards that may impact a large number of people. Mine subsidence can cause damage to buildings, disrupt underground utilities, and be a potential threat to human life. In extreme cases, mine subsidence can literally swallow whole buildings or sections of ground into sinkholes, endangering anyone that may be present at that site. Mine subsidence may take years to manifest.

Salt/Solution Mining

Michigan also has one of the world's largest underground salt accumulations. The thickest salt beds lie under most of the Lower Peninsula. A large deposit lies under the City of New Baltimore and Chesterfield Township. These formations are, in some places, over 3,000 feet thick and composed of layers of salt and other minerals.

Action Plan

Probably the most effective way to mitigate subsidence hazards is through community education and awareness. Local officials in subsidence-prone areas need to be aware of their community's potential vulnerability to subsidence, and that awareness needs to be communicated to the public. In Macomb County, the only community to report subsidence hazards is St. Clair Shores. Historically, large amounts of dirt were used to fill in low areas (marsh). This may account for "sink holes" discovered in that city. The ability to predict a problem does not exist at this time. Officials in New Baltimore and Chesterfield have been notified that salt deposits exist under their respective communities. However, no problems are expected in the near future. The county's Office of Emergency Management should monitor potential problems. This project should be assigned to the Assistant Emergency Management Coordinator.

Hail Storms

Definition

A condition where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth.

Hazard Description

Hail is another product of the strong thunderstorms that frequently move across the county. As one of these thunderstorms passes over, hail usually falls near the center of the storm, along with the heaviest rain. Sometimes, strong winds occurring at high altitudes in the thunderstorm can blow the hailstones away from the storm center, causing an unexpected hazard at places that otherwise might not appear threatened.

Most hailstones range in size from a pea to a golf ball, but hailstones larger than baseballs have occurred with the most severe thunderstorms. Hail is formed when strong updrafts within the storm carry water droplets above the freezing level, where they remain suspended and continue to grow larger until their weight can no longer be supported by the winds. They finally fall to the ground, battering crops, denting autos, and injuring wildlife and people. Large hail is a characteristic of severe thunderstorms, and it may precede the occurrence of a tornado.

Macomb County agencies are warned via the Law Enforcement Information Network (LEIN) or National Oceanic and Atmospheric Administration (NOAA) weather radio. In Macomb County, public warning is provided through the Emergency Alert System (EAS). The National Weather Service stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The National Weather Service also provides detailed warning information on the Internet, through the Emergency Managers Weather Information Network (EMWIN).

Action Plan

The National Weather Service forecasts of severe thunderstorms usually give sufficient warning time to allow residents to take appropriate action to reduce the effects of hail damage to vehicles and some property. However, little can be done to prevent roof or most window damage, or damage to crops. No mitigation efforts can be identified at this time. Efforts of the county's Office of Emergency Management to increase the coverage of public warning systems, both outdoors and indoors should be encouraged. Also, the county should encourage strict enforcement of the Building Officials and Code Administration's Building Code as it pertains to structural integrity. This project should be assigned to the county's Assistant Emergency Management Coordinator.

Lightning

Definition

The discharge of electricity from within a thunderstorm.

Hazard Description

Lightning is a random and unpredictable product of a thunderstorm's tremendous energy. The energy in the storm produces an intense electrical field like a giant battery, with the positive charge concentrated at the top and the negative charge concentrated at the bottom. Lightning strikes when a thunderstorm's electrical potential (the difference between its positive and negative charges) becomes great enough to overcome the resistance of the surrounding air. Bridging that difference, lightning can jump from cloud to cloud, cloud to ground, ground to cloud, or even from the cloud to the air surrounding the thunderstorm. Lightning strikes can generate current levels of 30,000 to 40,000 amperes, with air temperatures often superheated to higher than 50,000 degrees Fahrenheit (hotter than the surface of the sun) and speeds approaching one-third the speed of light.

Globally, there are about 2,000 thunderstorms occurring at any given time, and those thunderstorms cause approximately 100 lightning strikes to the earth each second. In the United States, approximately 100,000 thunderstorms occur each year, and every one of those storms generates lightning. It is not uncommon for a single thunderstorm to produce hundreds or even thousands of lightning strikes. However, to the majority of the general public, lightning is perceived as a minor hazard. That perception lingers despite the fact that lightning damages many structures and kills and injures more people in the United States per year, on average, than tornadoes or hurricanes. Many lightning deaths and injuries could be avoided if people would have more respect for the threat lightning presents to their safety.

The electrical force shocking the heart into cardiac arrest or throwing the heartbeat out of its usual rhythm usually causes lightning deaths. Lightning can also cut off breathing by paralyzing the chest muscles or damaging the respiratory center in the brain stem. It takes only about one-hundredth of an ampere of electric current to stop the human heartbeat or send it into ventricular fibrillation. Lightning can also cause severe skin burns that can lead to death if complications from infection set in.

Statistics compiled by the National Oceanic and Atmospheric Administration (NOAA) and the National Lightning Safety Institute (NLSI) for the period 1959-1994 revealed the following about lightning fatalities, injuries and damage in the United States:

Location of Lightning Strikes

- 40% are at unspecified locations
- 27% occur in open fields and recreation areas (not golf courses)
- 14% occur to someone under a tree (not on golf course)
- 8% are water-related (boating, fishing, swimming, etc.)
- 5% are golf-related (on golf course or under tree on golf course)
- 3% are related to heavy equipment and machinery
- 2.4% are telephone-related
- .7% are radio, transmitter and antenna-related

Action Plan

Unfortunately, lightning prevention or protection, in an absolute sense, is impossible. However, the consequences of lightning strikes have been diminished (both in terms of deaths and

injuries and property damage) through the implementation of several programs and special initiatives.

Early detection, monitoring, and warning of lightning hazards, combined with prudent protective actions, can greatly reduce the likelihood of lightning-related injuries and deaths. The National Weather Service issues warnings for storms, which may include lightning. Macomb County has recently installed lightning protection for its communication center and has hired a consultant, OmniCom, to conduct a needs assessment to ensure that the county's radio towers are adequately protected. In addition, close coordination between event organizers, local emergency management officials, and response agencies (i.e., police, fire, emergency medical care) can help prevent unnecessary (and often tragic) delays and mistakes in rendering care should a lightning-related incident occur. The county is encouraging local communities to strictly enforce the lightning protection requirements of the Building Officials Code Administrators' Building Code.

Severe Winds

Definition

Winds of 58 miles per hour or greater.

Hazard Description

Severe winds spawned by thunderstorms or other storm events have had devastating effects on Macomb County in terms of property damage. According to data compiled by the National Weather Service for the period 1970-1996, Michigan experienced over 8,300 severe wind events (does not include tornadoes), which resulted in 98 deaths and millions of dollars in damage. It is important to note that the high number of severe wind events is due in part to the fact that the counties compiled the data; thus, multi-county storms are counted more than once. Severe wind events are characterized by wind velocities of 58 miles per hour or greater, with gusts sometimes exceeding 74 miles per hour (hurricane velocity).

Significant Severe Wind Events

On July 21, 1998, severe thunderstorms passed through the metro-Detroit area, producing strong winds that killed three persons, damaged or destroyed nearly 200 homes, and downed trees and power lines. Wind speeds were estimated at 70-80 miles per hour, roughly equivalent to a weak hurricane. The storms affected 34 jurisdictions in Wayne County, and five jurisdictions in Macomb County. Over 430,000 electrical customers were left without power. Total storm-related public damage was in excess of \$6.8 million. A Presidential Major Disaster Declaration was granted for the two counties, providing both public and hazard mitigation assistance to affected local jurisdictions.

Action Plan

Many of the programs and initiatives designed to mitigate against, prepare for, respond to, and recover from tornadoes have the dual purpose of also protecting against severe straight-line winds. Local communities in Macomb have announced plans to activate their emergency warnings systems for wind events in excess of 70 miles per hour. This project is assigned to the county's Emergency Management Coordinator. County and local officials have met with manufactured home parks in Macomb County to promote the use of safe rooms. At this time, county officials have encountered a great deal of resistance from the manufactured home park owners due to, they claimed, increased liability on their part. County officials are working with state officials to encourage manufactured home parks to build safe rooms. The county is also encouraging the use of tree landscaping to reduce the effects of severe winds on manufactured home sites.

Tornadoes

Definition

An intense rotating column of wind that extends from the base of a severe thunderstorm to the ground.

Hazard Description

Tornadoes in Macomb County are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the polar regions to generate severe thunderstorms. These thunderstorms often produce the violently rotating columns of wind that are called tornadoes. Macomb County lies at the northeastern edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Missouri, Illinois, Indiana, and Ohio. Most of a tornado's destructive force is exerted by the powerful winds that knock down walls and lift roofs from buildings in the storm's path. The violently rotating winds then carry debris aloft that can be blown through the air as dangerous missiles.

A tornado may have winds up to 300 miles per hour and an interior air pressure that is 10-20 percent below that of the surrounding atmosphere. The typical length of a tornado path is approximately 16 miles, but tracks much longer than that, even up to 200 miles, have been reported. Tornado path widths are generally less than one-quarter mile wide. Typically, tornadoes last only a few minutes on the ground, but those few minutes can result in tremendous damage and devastation. Historically, tornadoes have resulted in tremendous loss of life, with the mean national annual death toll being 111 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year.

Tornado Intensity

Tornado intensity is measured on the Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings, and other man-made structures. The Fujita Scale rates the intensity of a tornado based on damage caused, not by its size. It is important to remember that the size of a tornado is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be extremely strong, and vice versa. It is very difficult to judge the intensity and power of a tornado while it is occurring. Generally, that can only be done after the tornado has passed, using the Fujita Scale as the measuring stick.

According to the National Weather Service (NWS), since 1950, the vast majority of tornadoes that occurred in the United States (approximately 74%) were classified as weak tornadoes (F0 or F1 intensity). Approximately 25% were classified as strong tornadoes (F2 or F3 intensity), and only 1% was classified as violent tornadoes (F4 or F5 intensity). Unfortunately, those violent tornadoes, while few in number, caused 67% of all tornado-related deaths nationally. Strong tornadoes accounted for another 29% of tornado-related deaths, while weak tornadoes caused only 4% of tornado-related deaths. If the data prior to 1950 is examined, the percentage of deaths attributable to violent tornadoes climbs drastically. That is largely due to the fact that tornado forecasting and awareness programs were not yet established. As a result, it was not uncommon for death tolls from a single tornado to reach several hundred.

National Weather Service Doppler Radar

The National Weather Service recently completed a major modernization program designed to improve the quality and reliability of weather forecasting. The keystone of this improvement is Doppler Weather Surveillance Radar, which can more easily detect severe weather events that threaten life and property, including tornadoes and the severe storms that spawn them. Most important, the lead time and specificity of warnings for severe weather have improved significantly.

Doppler technology calculates both the speed and the direction of motion of severe storms. By providing data on the wind patterns within developing storms, the new system allows forecasters to better identify the conditions leading to severe weather such as tornadoes and severe thunderstorms. This means early detection of the precursors to severe storms, as well as information on the direction and speed of storms once they form.

National Weather Service Watches/Warnings

The National Weather Service issues tornado watches for areas when the meteorological conditions are conducive to the development of a tornado. People in the watch area are instructed to stay tuned to local radio or television stations for weather updates, and watch for developing storms. Once a tornado has been sighted and its existence is confirmed and reported, or Doppler Radar shows strong probability of the development or occurrence of a tornado, the National Weather Service will issue a tornado warning. The warning will identify where the tornado was sighted, the direction in which it is moving, and the time frame during which the tornado is expected to be in the area. Persons in the warning area are instructed to seek shelter immediately.

Macomb County is warned via the Law Enforcement Information Network (LEIN) or National Oceanic and Atmospheric Administration (NOAA) weather radio. Public warning is provided through the Emergency Alert System (EAS). The National Weather Service stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The National Weather Service also provides detailed warning information on the Internet, through the Emergency Managers Weather Information Network (EMWIN).

Programs and Initiatives

Public Warning Systems

Numerous communities in Michigan have outdoor warning siren systems in place to warn the public about impending tornadoes and other hazards. Most of these systems were originally purchased to warn residents of a nuclear attack, but that purpose was expanded to include severe weather hazards as well. These systems can be very effective at saving lives in densely populated areas where the siren warning tone is most audible. In more sparsely populated areas where warning sirens are not as effective, communities are turning to NOAA weather alert warning systems to supplement or supplant outdoor warning siren systems.

Manufactured Homes

Manufactured homes are vulnerable to tornado damage if they are not properly anchored down. The Michigan Manufactured Housing Commission Administrative Rules (R 125.1602, Subsection 5) require new manufactured home installations in floodplains to be structurally anchored to a foundation. Through this requirement, the possibility of damage from wind is minimized. Although this will not protect a manufactured home from a direct hit by a tornado; it certainly will help prevent rollovers in most high-wind situations. Unfortunately, structures outside designated floodplains do not have to comply with the anchoring provision, although many owners choose to comply voluntarily. It should also be noted that local communities have the option of adopting an ordinance that requires anchoring of manufactured home installations located outside a designated floodplain. State anchoring system standards are outlined in Administrative Rules R 125.1605 through R 125.1608.

Electrical Infrastructure Reliability

One of the major problems associated with the severe winds from tornadoes and thunderstorms is the loss of electric power caused by trees falling onto power lines. Macomb County has had numerous widespread and severe electrical power outages caused by severe wind and other weather events. Wind-related damage to electric power facilities and systems is a concern that is being actively addressed by Detroit Edison. Detroit Edison has an active, ongoing program to improve system reliability and protect facilities from damage by tornadoes, severe straight-line winds, and other hazards. Typically, these programs focus on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting

equipment from lightning strikes, and placing new distribution lines underground. A potential outcome of this study is to have the County's Emergency Management staff work with local community leaders and planners to inform builders and residents regarding urban forestry to prevent trees from being planted that would eventually cause future problems.

Action Plan

Most tornadoes in Macomb County come from the southwest and travel northeast. In general, improved surveillance and warning systems implemented by communities in Macomb County and emergency management agencies, coupled with extensive public education campaigns, may prove to be very effective in keeping the death toll and damages down. However, this is not to say that a major death toll could not occur again if a severe tornado should strike a highly populated area. History has clearly shown that tornadoes must always be treated with the utmost respect and caution. Other initiatives, such as structural bracing presently being studied, urban forestry practices, manufactured home anchoring, and strengthening electrical system components, can help to reduce public and private property damage. Although tornadoes cannot be predicted, prevented or contained, their potential impacts on Macomb County's citizens and communities can certainly be reduced. To reduce the effects of tornadoes, the county's Office of Emergency Management should encourage local communities to expand their tornado warning systems and to encourage safe rooms for the manufactured home parks in Macomb County.

Transportation Accidents

Definition

A crash or accident involving an air, land or water-based commercial passenger carrier.

Hazard Description

Air Transportation Accidents

Macomb County has three airports and one military base. The City of Detroit and the Marine City Airports are located near Macomb County. There is frequent use of helicopters by law enforcement, military, emergency medical services, construction and industry. Macomb County has experienced many transportation accidents involving military aircraft as Selfridge ANG Base is the oldest military air facility in the US and is used today primarily as a training facility.

There are four circumstances that can result in an air transportation accident:

- 1) An aircraft colliding with another aircraft in the air;
- 2) An aircraft crashing while in the cruise phase of a flight due to mechanical problems, sabotage, or other cause;
- 3) An aircraft crashing while in the takeoff or landing phases of a flight; or
- 4) Two or more aircraft colliding with one another on the ground during staging or taxi operations.

When responding to any of these types of air transportation accidents, emergency personnel may be confronted with a number of problems, such as:

- 1) Suppressing fires
- 2) Rescuing and providing emergency first aid for survivors
- 3) Establishing mortuary facilities for victims
- 4) Detecting the presence of explosive or radioactive materials; and
- 5) Providing crash site security, crowd and traffic control, and protection of evidence.

Land Transportation Accidents

A land transportation accident in Macomb County could involve a commercial passenger bus, a local public transit bus, a school bus, or a train. Although these modes of land transportation have a good safety record, accidents do occur. Typically, bus accidents are caused by the bus slipping off the roadway in inclement weather, or colliding with another vehicle. Train accidents usually involve a collision with a vehicle attempting to cross the railroad tracks before the train arrives at the crossing. Unless the train accident results in a major derailment or carries hazardous materials, serious injuries are usually kept to a minimum. Bus accidents, on the other hand, can be quite serious, especially if the bus has tipped over. Numerous injuries are a very real possibility in those types of situations.

Dangerous Intersections in Macomb County

The following sites are Macomb County's high-crash intersections, over a 5-year study from 1997 to 2001, done by Southeast Michigan Council of Governments:

Intersections

1. Van Dyke & 18 Mile Road
(No. 1 in Michigan)
2. Groesbeck and 16 Mile Road

- (No. 2 in Michigan)
3. Gratiot and 16 Mile Road
(No. 3 in Michigan)
 4. Hall and Hayes
(No. 4 in Michigan)
 5. Gratiot and 23 Mile Road
(No. 7 in Michigan)
 6. Hall and Schoenherr
(No. 9 in Michigan)

Water Transportation Accidents

A water transportation accident could have significant life safety consequences. Macomb County has numerous marinas in St. Clair Shores, its Nautical Mile is well known throughout the boating community. Large marinas can be found in Harrison and Chesterfield Townships and the City of New Baltimore. Both the Macomb County Sheriff and the US Coast Guard patrol Lake St. Clair. At this time, passenger ferry service does not exist, but cruise ships that pass near Macomb County are becoming more popular.

The one commonality all transportation accidents share, whether air, land or water-based, are that more often than not they result in mass casualties. Air transportation accidents, in particular, can result in tremendous numbers of deaths and injuries and major victim identification and crash scene management problems. Water transportation accidents, on the other hand, may require a significant underwater rescue and recovery effort. Harrison Township Fire Department is well trained for handling water (ice) rescues. Selfridge ANG Base Fire Department is part of the county's mutual aid pact and provides excellent fire fighting equipment and a well-trained crash/rescue team.

Action Plan

The county's Office of Emergency Management will work with local communities and the Macomb County Road Commission, where dangerous intersections have been identified, to reduce the potential for large loss of life incidents. The county's Emergency Management Coordinator will also work with federal government officials to plan, train and prepare for an aircraft incident. On May 09, 2002, the County conducted a mock disaster involving federal, state, and local response agencies involving the crash of a military aircraft into a sparsely populated area of the county.

Ice and Sleet Storms

Definition

A storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or property damage.

Hazard Description

Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is similar to hail only smaller and can be easily identified as frozen rain drops (ice pellets) which bounce when hitting the ground or other objects. Sleet does not stick to trees and wires, but sleet in sufficient depth does cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surface, coating the ground, trees, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. When electric lines are downed, households may be without power for several days, resulting in significant economic loss and disruption of essential services in affected communities.

Programs and Initiatives

National Weather Service Doppler Radar

The National Weather Service (NWS), located in White Lake Township, has recently completed a major modernization program designed to improve the quality and reliability of weather forecasting. The keystone of this improvement is Doppler Weather Surveillance Radar, which can more easily detect severe weather events that threaten life and property - including severe winter weather events such as ice and sleet storms. Most important, the lead-time and specificity of warnings for severe weather have improved significantly.

National Weather Service Watches/Warnings

Sufficient warning can do much to reduce the damage from ice and sleet storms by permitting people to prepare properly. The National Weather Service uses the terms "ice storm", "freezing rain", and "freezing drizzle", to warn the public when a coating of ice is expected on the ground and on other exposed surfaces. The qualifying term "heavy" is used to indicate ice coating which, because of the extra weight of the ice, could cause significant damage to trees, overhead wires, and other exposed objects.

State and local government agencies are warned via the Law Enforcement Information Network (LEIN) or National Oceanic and Atmospheric Administration (NOAA) weather radio. Public warning is provided through the Emergency Alert System (EAS). The National Weather Service stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The National Weather Service also provides detailed warning information on the Internet, through the Emergency Managers Weather Information Network (EMWIN).

Winter Hazards Awareness Week

Each fall, the Macomb County Emergency Management Office in conjunction with the Michigan Severe Weather Awareness Committee, sponsors Winter Hazards Awareness Week. This annual public information and education campaign focuses on winter weather hazard events such as snowstorms, blizzards, extreme cold, and ice and sleet storms. Informational materials on winter weather hazards and safety are disseminated to schools, hospitals, nursing homes, other interested community groups and facilities, and the general public.

Electrical Infrastructure Reliability

One of the major problems associated with ice storms is the loss of electric power. Macomb County has had numerous widespread and severe electrical power outages caused by ice storms, several of which have resulted in a power loss to thousands of electrical customers for several hours to several days at a time. Ice-related damage to electric power facilities and systems is a concern that is being actively addressed by utility companies across the state. Detroit Edison, who serves one hundred percent of Macomb County electrical power, has an active, ongoing program to improve system reliability and protect facilities from damage by ice, severe winds, and other hazards. Typically, these programs focus on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting equipment from lightning strikes, and placing new distribution lines underground. The Michigan Public Service Commission (MPSC) monitors power system reliability to help minimize the scope and duration of power outages.

Analysis and Impact

Approximately 84% of ice storms occurred during the months of January, February, March and April, when conditions are most conducive for the development of ice and sleet. Nearly half of all ice and sleet storms in the period occurred during the month of March. Communities near Lake St. Clair, such as St. Clair Shores, Harrison and Chesterfield Townships and the City of new Baltimore may be the hardest hit. By observing winter storm watches and warnings, adequate preparations can usually be made to lessen the impact of ice and sleet conditions on Macomb County communities. Providing for the mass care and sheltering of residents left without heat or electricity, and mobilizing sufficient resources to clear broken tree limbs from roadways, are the primary challenges facing community officials. Severe ice and sleet storms can affect every county community. Therefore, every community should plan and prepare for these emergencies. That planning and preparedness effort should include the identification of mass care facilities and necessary resources such as cots, blankets, food supplies and generators, as well as debris removal equipment and services. In addition, communities should also develop debris management procedures (to include the identification of multiple debris storage, processing and disposal sites) so that the tree and other storm-related debris can be handled in the most expedient, efficient, and environmentally safe manner possible.

Action Plan

The county's Office of Emergency Management should assist local communities in developing an urban forestry program. Urban forestry programs can be very effective in minimizing ice storm damage caused by falling trees or tree branches. In almost every ice storm, falling trees and branches cause power outages and clog public roadways with debris. However, a properly designed, managed and implemented urban forestry program can help keep tree related damage and impact to a minimum. To be most effective, an urban forestry program should address tree maintenance in a comprehensive manner, from proper tree selection, to proper placement, to proper tree trimming and long-term care.

Every power company in Michigan has a tree trimming program in place, and numerous local communities, such as St. Clair Shores and Mount Clemens, have some type of tree maintenance program in place. The electrical utility tree trimming programs are aimed at preventing encroachment of trees and tree limbs within power line rights-of-way. Also, crews from the county road commission perform tree-trimming work.

When proper pruning methods are employed, and when the work is done on a regular basis with the aim of reducing potential storm-related damage, these programs can be quite effective. Often, however, tree-trimming work is deferred when budgets get tight or other work is deemed a higher priority. When that occurs, the problem usually manifests itself in greater storm-related tree debris management problems down the line.

Snowstorms

Definition

A period of rapid accumulation of snow often accompanied by high winds, cold temperatures, and low visibility.

Hazard Description

As a result of being near the Great Lakes, Macomb County experiences large differences in snowfall in relatively short distances. The annual mean accumulation ranges from 22 to 40 inches of snow. The highest accumulations are in the northern and western parts of the Macomb County due to the higher elevation in Washington and Bruce Townships.

Blizzards are the most dramatic and perilous of all snowstorms, characterized by low temperatures and strong winds (35+ miles per hour) bearing enormous amounts of snow. Most of the snow accompanying a blizzard is in the form of fine, powdery particles that are wind-blown in such great quantities that, at times, visibility is reduced to only a few feet. Blizzards have the potential to result in property damage and loss of life. Just the cost of clearing the snow can be enormous.

National Weather Service Doppler Radar

The National Weather Service has recently completed a major modernization program designed to improve the quality and reliability of weather forecasting. The keystone of this improvement is Doppler Weather Surveillance Radar, which can more easily detect severe weather events that threaten life and property, including severe winter weather events such as snowstorms. Most important, the lead-time and specificity of warnings for severe weather have improved significantly.

National Weather Service Watches, Warnings and Advisories

The National Weather Service issues winter storm watches and winter weather warnings to notify the public of severe winter weather conditions. A winter storm watch indicates severe winter weather conditions (freezing rain, sleet, or heavy snow) which may affect an area, while a winter weather warning indicates that severe winter weather conditions are imminent.

Winter storm warnings can be issued for snow alone, but they also can take on different varieties. For example, a blizzard warning signifies that blizzard conditions are imminent or occurring. Blizzard conditions mean that the visibility will frequently be one-quarter mile or less in falling or blowing snow, with wind speeds at least 35 miles per hour. A wind chill warning is issued when wind chills drop below minus 50 degrees Fahrenheit with winds equal to or greater than 10 miles per hour. Finally, an ice storm warning is issued for a significant accumulation of ice, normally a coating of at least one-quarter inch. However, if winds are less than 15 miles per hour, an ice storm warning may be issued when the ice accumulation is expected to be one-half inch.

The National Weather Service also issues a number of different advisories for winter weather. These advisories can be issued for snow, freezing rain, blowing snow, and wind chill, among other things. Advisories mean that conditions are expected to cause significant inconveniences and may be hazardous. However, if caution is exercised, the situation should not become life threatening.

Emergency Management in Macomb County is warned via the Law Enforcement Information Network (LEIN) or National Oceanic and Atmospheric Administration (NOAA) weather radio. Public warning is provided through the Emergency Alert System (EAS). The National Weather Service stations in Michigan transmit information directly to radio and television stations, which in turn pass the warning on to the public. The National Weather Service also provides detailed warning information on the Internet, through the Emergency Managers Weather Information Network (EMWIN).

Winter Hazards Awareness Week

Each fall, the Emergency Management Division, Department of State Police, in conjunction with the Michigan Severe Weather Awareness Committee, sponsors Winter Hazards Awareness Week. This annual public information and education campaign focuses on winter weather hazard events such as snowstorms, blizzards, extreme cold, and ice and sleet storms. Informational materials on winter weather hazards and safety are disseminated to schools, hospitals, nursing homes, other interested community groups and facilities, and the general public.

Action Plan

The Macomb County Road Commission maintains the roads. They are alerted if a snowstorm alert is given. The county monitors weather conditions and reacts if weather conditions become hazardous. Historical data reveals Macomb County does not receive the snowfall as experienced by the rest of the state. Constant monitoring of weather conditions is important to respond with adequate equipment and manpower. The county's Office of Management should update its emergency list of contractors in the event of a major storm to assist county personnel to recover from a snow storm.

RISK ASSESSMENT

A risk assessment involves the examination of the county's hazards using objective evaluation measures. Through this evaluation process, hazards are identified in detail and an overall risk to those hazards can be assessed in terms of potential impact on people, services, and specific facilities and structures.

Risk Assessment

Establishment of Hazard Evaluation Measures

In this analysis, each hazard facing Macomb County communities was evaluated using a common set of five (5) measures. Those measures are:

1. The likelihood of occurrence.
2. The significance of impact.
3. The frequency of occurrence.
4. The potential size of the affected area
5. The impact on the affected area.

Advanced Hazards Profile and Evaluation

This model uses a common set of 11 evaluation measures and 44 corresponding benchmark factors to evaluate each hazard facing the community (county).

Charts

The following charts were used to increase the accuracy and precision of the study.

RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
CIVIL DISTURBANCES 100. A public demonstration or gathering that results in disruption of essential functions, rioting, looting, arson or other unlawful behavior.	100.1 Yes (Prisons, large industrial sites, college campuses, military installations, defense contractors)	100.2 Yes	100.3 Once every 5 years	100.4 Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	100.5 Number of People: 1,000+
DROUGHT 101. A prolonged period without rain, particularly during the planting and growing seasons in agricultural areas.	101.1 Yes (Northern/Central Macomb County and lakeshore recreational facilities)	101.2 Yes	101.3 Once every 25 years	101.4 Large area (3+ twps. or 1/2 of municipality)	101.5 Number of People: 10,000+
EARTHQUAKES 102. A shaking or trembling of the crust of the earth caused by the breaking and shifting of rock beneath the surface.	102.1 Yes (New Madrid Fault may pose threat)	102.2 No	102.3 Has not occurred	102.4 Large area (3+ twps. or 1/2 of municipality)	102.5 Number of People: 1,000+
EXTREME TEMPERATURES 103. Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions.	103.1 Yes (Public health as well as infrastructure damage)	103.2 Yes	103.3 Once or more a year	103.4 Large area (3+ twps. or 1/2 of municipality)	103.5 Number of People: 700,000+

RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
FIRE HAZARDS: SCRAP TIRE FIRES 104. Any instance of uncontrolled burning at a scrap tire storage or recycling site.	104.1 Yes (One site in the City of Warren)	104.2 Yes	104.3 Has not occurred	104.4 Single site (1 site in county or municipality)	104.5 Number of People: 100+
FIRE HAZARDS: STRUCTURAL FIRES 105. Any instance of uncontrolled burning which results in structural damage to properties in developed areas.	105.1 Yes (Largest frequency of incidents, low death and injury rate. Considered a high hazard due to the size of county industrial base. Many facilities have employment of 5,000 or more workers)	105.2 Yes	105.3 Once or more a year	105.4 Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	105.5 Number of People: 100+
FIRE HAZARDS: WILDFIRES 106. An uncontrolled fire in grass or brushlands, or forested areas.	106.1 Yes (Not a major hazard for the county)	106.2 Yes	106.3 Once or more a year	106.4 Small area (1-2 twps. or 1/4 of municipality)	106.5 Number of People: 100+
FLOOD HAZARDS: DAM FAILURES 107. The collapse or failure of an impoundment resulting in downstream flooding.	107.1 Yes (Dams in (3)Washington Twp. and (1)Sterling Heights)	107.2 Yes	107.3 Has not occurred	107.4 Large area (3+ twps. or 1/2 of municipality)	107.5 Number of People: 1,000+

RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
FLOOD HAZARDS: RIVERINE/URBAN FLOODING 108. <u>Riverine:</u> Periodic overbank flows of rivers and streams. <u>Urban:</u> Overflow of storm sewer systems following heavy rain or snowmelt.	108.1 Yes (For communities in the Clinton River watershed, this hazard has caused millions of dollars in damage. Great potential for infrastructure damage.)	108.2 Yes	108.3 Once every 5 years	108.4 Large area (3+ twps. or 1/2 of municipality)	108.5 Number of People: 100,000+
FLOOD HAZARDS: SHORELINE FLOODING AND EROSION 109. Flooding/erosion along the Great Lakes shoreline due to high water levels, storm surges, or high winds.	109.1 Yes (Erosion may be more of a problem during periods of low water levels.)	109.2 Yes	109.3 Once every 5 years	109.4 Large area (3+ twps. or 1/2 of municipality)	109.5 Number of People: 10,000+
HAZARDOUS MATERIAL INCIDENT: FIXED SITE 110. An uncontrolled release of hazardous materials from a fixed site.	110.1 Yes (Over 100 Section 302 sites. Large chemical, plastics and paint operations.)	110.2 Yes	110.3 Once or more a year	110.4 Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	110.5 Number of People: 1,000-5,000
HAZARDOUS	111.1	111.2	111.3	111.4	111.5

MATERIAL INCIDENT: TRANSPORTATION 111. An uncontrolled release of hazardous materials during transport.	Yes (Canadian National and Conrail Railroad companies transport over 70 dangerous chemicals, some with evacuation distances over 7 miles.)	Yes	Once or more a year	Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	Number of People: 1,000-5,000+
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RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
INFRASTRUCTURE FAILURES 112. A failure of critical public or private utility infrastructure resulting in a temporary loss of essential functions and/or services.	112.1 Yes (May result due to weather conditions, storms, or terrorism.)	112.2 Yes	112.3 Once or more a year	112.4 Large area (3+ twps. or 1/2 of municipality)	112.5 Number of People: 700,000+
NUCLEAR ATTACK 113. Any hostile attack against the United States, using nuclear weapons, which results in destruction of military and/or civilian targets.	113.1 Yes	113.2 Yes	113.3 Has not occurred	113.4 Large area (3+ twps. or 1/2 of municipality)	113.5 Number of People: 700,000+
NUCLEAR POWER PLANT ACCIDENTS 114. An actual or potential release of radioactive material at a commercial nuclear power plant.	114.1 Yes (County is within secondary planning zone for the Enrico Fermi Power Plant in Monroe, MI.)	114.2 Yes	114.3 Has not occurred	114.4 Large area (3+ twps. or 1/2 of municipality)	114.5 Number of People: 100,000+
OIL AND GAS WELL ACCIDENTS 115. An uncontrolled release of oil or gas, or the poisonous by-product	115.1 Yes (Macomb County has more than 600 oil and gas wells.)	115.2 Yes	115.3 Once every 25 years	115.4 Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	115.5 Number of People: 100+

hydrogen sulfide, from wells.					
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RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
PETROLEUM AND GAS PIPELINE ACCIDENTS 116. An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline.	116.1 Yes	116.2 Yes	116.3 Once every 25 years	116.4 Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	116.5 Number of People: 100+
PUBLIC HEALTH EMERGENCIES 117. A widespread and/or severe epidemic, incident of contamination, or other situation that presents a danger to the public health.	117.1 Yes	117.2 Yes	117.3 Once every 5 years	117.4 Large area (3+ twps. or 1/2 of municipality)	117.5 Number of People: 1-700,000+
SABOTAGE / TERRORISM 118. An intentional, unlawful use of force or violence against persons or property to intimidate or coerce a govt. or the population, in furtherance of specific objectives.	118.1 Yes (Great potential for infrastructure damage.)	118.2 Yes	118.3 Has not occurred	118.4 Multiple sites (more than 1 site in 1 twp. or more than 1 site in municipality)	118.5 Number of People: 100-1,000+
SUBSIDENCE 119. Depressions, cracks, and sinkholes in the ground	119.1 Yes (Great potential for infrastructure damage.)	119.2 Yes	119.3 Once every 5 years	119.4 Single site (1 site in county or municipality)	119.5 Number of People: 10-100+

surface caused by mining, earthquakes, extensive groundwater withdrawal, or other sub-surface activities or phenomena.	One community reported subsidence events-St. Clair Shores.)				
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RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
THUNDERSTORM HAZARDS: HAILSTORMS 120. A condition where atmospheric water particles from thunderstorms form into lumps of ice that fall to earth	120.1 Yes	120.2 Yes	120.3 Once or more a year	120.4 Large area (3+ twps. or 1/2 of municipality)	120.5 Number of People: 1,000+
THUNDERSTORM HAZARDS: LIGHTNING 121. The discharge of electricity from within a thunderstorm.	121.1 Yes (Great potential for infrastructure damage.)	121.2 Yes	121.3 Once or more a year	121.4 Large area (3+ twps. or 1/2 of municipality)	121.5 Number of People: 10-1,000+
THUNDERSTORM HAZARDS: SEVERE WINDS (WINDSTORMS) 122. Winds in excess of 58 miles per hour.	122.1 Yes (Great potential for infrastructure damage.)	122.2 Yes	122.3 Once or more a year	122.4 Large area (3+ twps. or 1/2 of municipality)	122.5 Number of People: 700,000+
THUNDERSTORM HAZARDS: TORNADOES 123. A violently whirling column of air extending downward to the ground from a cumulonimbus	123.1 Yes (Large manufactured home sites in Macomb, Chesterfield, Clinton Lenox, Washington, and Harrison Twsp. Also, great potential for	123.2 Yes	123.3 Once or more a year	123.4 Large area (3+ twps. or 1/2 of municipality)	123.5 Number of People: 10-700,000+

cloud.	infrastructure damage.)				
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RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
TRANSPORTATION ACCIDENTS: AIR, LAND AND WATER 124. A crash or accident involving an air, land or water-based commercial passenger carrier resulting in death or serious injury.	124.1 Yes	124.2 Yes	124.3 Once every 10 years	124.4 Single site (1 site in county or municipality)	124.5 Number of People: 1-250+
SEVERE WINTER WEATHER HAZARDS: ICE AND SLEET STORMS 125. A storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or damage.	125.1 Yes (Great potential for infrastructure damage.)	125.2 Yes	125.3 Once or more a year	125.4 Large area (3+ twps. or 1/2 of municipality)	125.5 Number of People: 1,000-700,000+
SEVERE WINTER WEATHER HAZARDS: SNOWSTORMS 126. A period of rapid accumulation of snow often accompanied by high winds, cold temperatures, and low visibility.	126.1 Yes (Great potential for infrastructure and economic damage.)	126.2 Yes	126.3 Once or more a year	126.4 Large area (3+ twps. or 1/2 of municipality)	126.5 Number of People: 1,000-700,000+
Selfridge Air National Guard Base	127.1 Yes	127.2 Yes	127.3 Once every 5 years	127.5 Single site (1 site in county or municipality)	127.4 Number of People:

127. Military installation.					100+
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RISK ASSESSMENT: Hazards Identification and Evaluation

HAZARD	LIKELIHOOD OF OCCURRENCE 1. Could this hazard affect your jurisdiction?	SIGNIFICANCE OF IMPACT 2. Is this hazard a significant threat to your jurisdiction?	FREQUENCY OF OCCURRENCE 3. Approximately how often does this hazard occur in your jurisdiction?	POTENTIAL SIZE OF AFFECTED AREA 4. What is the size of the geographic area that could potentially be affected by this hazard?	POPULATION IMPACT 5. What is your best estimate of the total population that could be seriously affected by this hazard?
T.A.C.O.M. 128. Military installation	128.1 Yes	128.2 Yes	128.3 Once every 5 years	128.4 Single site (1 site in county or municipality)	128.5 Number of People: 10-100+
Macomb Center for the Performing Arts 129. Fixed site with terrorism potential-large assembly of people .)	129.1 Yes	129.2 Yes	129.3 Has not occurred	129.4 Single site (1 site in county or municipality)	129.5 Number of People: 10-1,000+
Freedom Hill 130. Fixed outdoor site with terrorism potential-large assembly of people. Also has potential for affect due to severe weather.	130.1 Yes	130.2 Yes	130.3 Once or more a year	130.4 Single site (1 site in county or municipality)	130.5 Number of People: 100-10,000+
Holiday Fireworks Displays 131.	131.1 Yes	131.2 Yes	131.3 Once or more a year	131.4 Large area (3+ twps. or 1/2 of municipality)	131.5 Number of People: 10-100+

Advanced Hazards Profile and Evaluation Evaluation Measures and Benchmark Factors for Each Measure

This model uses a common set of 11 evaluation measures and 44 corresponding benchmark factors to evaluate each hazard facing the community (Macomb County). Those measures are: 1) historical occurrence; 2) affected area; 3) speed of onset; 4) population impact (casualties); 5) economic effects; 6) duration; 7) seasonal pattern; 8) predictability; 9) collateral damage potential; 10) availability of warnings; and 11) mitigative potential. Each corresponding benchmark factor has been assigned a specific point value (10, 7, 4 or 1 point), based on each individual factor's relative severity and negative impacts. The following is a synopsis of each hazard evaluation measure and the benchmark factor used in this analysis:

Historical Occurrence

Historical occurrence measures the frequency with which a particular hazard occurs in Macomb County. The more frequently a hazard event occurs, the more potential there is for damage and negative impact. The specific benchmark factors used in the historical occurrence analysis are:

Excessive Occurrence, indicating the hazard event is likely to occur 4 or more times in one year;

High Occurrence, indicating the hazard event is likely to occur 2-3 times per year;

Medium Occurrence, indicating the hazard event is likely to occur 1 time per year;

Low Occurrence, indicating the hazard event occurs less than 1 time per year (i.e., once every 4 years).

Benchmark factor point values are:

- 1 pt. Low (<1 event/yr.)
- 4 pts. Medium (1 event/yr.)
- 7 pts. High (2-3 events/yr.)
- 10 pts. Excessive (4+ events/yr.)

Affected Area

Each hazard affects a geographic area. For example, a blizzard might affect an entire state, while a flood might only affect a portion of a county or municipality. Although size of the affected area is not always indicative of the destructive potential of the hazard (a tornado is a good example), generally the larger the affected area, the more problematic the hazard event is on a community. The specific benchmark factors used in the affected area analysis are:

Large Area, if a hazard event has the potential to impact 3 or more townships in a county, or 1/2 of a municipality;

Small Area, if the hazard event could impact 1 or 2 townships in a county, or 1/4 of a municipality;

Multiple Sites, if the hazard event could impact more than 1 village, city, or other sites within 1 township, or more than 1 neighborhood or other site within a municipality;

Single Site, if the hazard event is likely to impact only 1 village, city or other site within a county, or 1 neighborhood or other site within a municipality.

Benchmark factor values are:

- 1 pt. Single Site (1 municipality/1 site in county)
- 4 pts. Multiple Sites (>1 municipality/>1 site in county)
- 7 pts. Small Area (multiple townships in county/>1/4 of municipality)
- 10 pts. Large Area (>3 townships/>1/2 municipality)

Speed of Onset

Speed of onset refers to the amount of time it typically takes for a hazard event to occur. Speed of onset is an important evaluation measure because the faster an event occurs, the less time local governmental agencies typically have to warn the potentially impacted population of appropriate protective actions. The specific benchmark factors used in the speed of onset analysis are:

Minimal or No Warning, indicating that the hazard event could occur without any advance notice or warning;

Less than 12 Hours, indicating the hazard event generally allows less than 12 hours advance notice before occurring;

12-24 Hours, indicating the hazard event generally allows 12-24 hours advance notice before occurring;

Greater than 24 Hours, indicating the hazard event generally allows more than 24 hours advance notice before occurrence.

Specific benchmark factor values are:

- 1 pt. >24 Hours
- 4 pts. 12-24 Hours
- 7 pts. <12 Hours
- 10 pts. Minimal/None

Population Impact

Population impact refers to the number of casualties (deaths and injuries) that can be expected if a particular hazard event occurs. Specific benchmark factors used in the population impact analysis are:

High Impact, indicating 10 or more casualties can be expected; Medium Impact, indicating 6-10 casualties can be expected;

Low Impact, indicating 1-5 casualties can be expected;

No Impact (none), indicating that no casualties can be expected.

Specific benchmark factor values are:

- 1 pt. None (no casualties)
- 4 pts. Low (1-5 casualties)
- 7 pts. Medium (6-10 casualties)
- 10 pts. High (10+ casualties)

Economic Effects

Economic effects are the monetary damages incurred from a hazard event, and include both public and private damage. Direct physical damage costs, as well as indirect impact costs such as lost business and tax revenue, are included as part of the total monetary damages. Specific benchmark factors used in the economic effects impact analysis are:

Significant Effects, indicating over \$100,000 in monetary damages incurred;
Medium Effects, indicating \$50,001-\$100,000 in monetary damages incurred;
Low Effects, indicating \$10,000-\$50,000 in monetary damages incurred;
Minimal Effects, indicating less than \$10,000 in monetary damages incurred.

Specific benchmark factor values are:

- 1 pt. Minimal (<\$10,000)
- 4 pts. Low (\$10,000-\$50,000)
- 7 pts. Medium (\$50,001-\$100,000)
- 10 pts. Significant (>\$100,000)

Duration

Duration refers to the time period the hazard event is actively present and causing damage (often referred to as the "time on the ground".) Duration is not always indicative of the damaging potential of a hazard event (a tornado is a good example). However, in most cases, the longer an event is "active" and thus causing damage, the greater the total damages will be. Specific benchmark factors used in the duration analysis are:

Long Duration, indicating the hazard event is likely to last longer than 1 week;
Medium Duration, indicating the hazard event is likely to last from 1 day to 1 week;
Short Duration, indicating the hazard event is likely to last from 12-24 hours;
Minimal Duration, indicating the hazard event is likely to last less than 12 hours.

Specific benchmark factor values are:

- 1 pt. Minimal (<12 hours)
- 4 pts. Short (12-24 hours)
- 7 pts. Medium (1 day-1 week)
- 10 pts. Long (>1 week)

Seasonal Pattern

Seasonal pattern refers to the time of year in which a particular hazard event can reasonably be expected to occur. Some hazard events can occur at any time of the year, while others occur primarily during one particular season (i.e., blizzards in winter). Oftentimes, hazard patterns coincide with peak tourism seasons and other times of temporary population increases, greatly increasing the vulnerability of the population to the negative impacts of certain hazard events. The specific benchmark factors used in the seasonal pattern analysis are:

Year-round Occurrences, indicating the hazard event can occur at any time of the year;
Three Season Occurrences, indicating the hazard event can realistically occur during 3 seasons of the year;
Two Season Occurrences, indicating the hazard event can realistically occur during 2 seasons of the year;
One Season Occurrences, indicating the hazard event realistically occurs during only 1 season of the year.

Benchmark factor values are:

1 pt.	1 Season
4 pts.	2 Seasons
7 pts.	3 Seasons
10 pts.	Year-round

Predictability

Predictability refers to the ease with which a particular hazard event can be predicted - in terms of time of occurrence, location, and magnitude. Predictability is important because the more predictable a hazard event is, the more likely it is a community will be able to warn the potentially impacted population and take other preventive measures to minimize loss of life and property. The specific benchmark factors used in the predictability analysis are:

Unpredictable, indicating the hazard is extremely difficult, if not impossible, to predict in terms of time of occurrence, location and magnitude;

Somewhat Predictable, indicating the time of occurrence, location and magnitude of the hazard can be predicted at less than 50% accuracy;

Predictable, indicating the time of occurrence, location and magnitude of the hazard can be predicted at 50% or greater accuracy;

Highly Predictable, indicating the time of occurrence, location and magnitude of the hazard is predictable virtually 100% of the time.

Benchmark factor values are:

1 pt.	Highly Predictable (100% accuracy)
4 pts.	Predictable (50%+ accuracy)
7 pts.	Somewhat Predictable (<50% accuracy)
10 pts.	Unpredictable (difficult/impossible)

Collateral Damage

Collateral damage refers to the possibility of a particular hazard event causing secondary damage and impacts. For example, blizzards and ice storms can cause power outages, which can cause loss of heat, which can lead to hypothermia and possible death or serious injury. Generally, the more collateral damage a hazard event causes, the more serious a threat the hazard is to a community. The specific benchmark factors used in the collateral damage analysis are:

High Possibility, indicating there is a great likelihood (76% or greater chance) that a particular hazard event will cause secondary hazard events and damage;

Good Possibility, indicating there is a higher than average likelihood (50-75% chance) that a particular hazard event will cause secondary hazard events and damage;

Some Possibility, indicating there is a less than average likelihood (less than 50% chance) that a particular hazard event will cause secondary hazard events and damage;

No Possibility, indicating there is virtually no likelihood (0% chance) that a particular hazard event will cause secondary hazard events and damage.

Benchmark factor point values are:

1 pt.	No Possibility
4 pts.	Some Possibility
7 pts.	Good Possibility
10 pts.	High

Availability of Warnings

Availability of warnings indicates the ease with which the public can be warned of a hazard. This measure does not address the availability of warning systems in a community. Rather, it looks at the overall availability of warning in general for a particular hazard event. For example, a community might receive warning that a flood will occur within 24 hours, but receive no warning when a large structural fire occurs. Generally, hazards that have little or no availability of warning tend to be more problematic for a community from a population protection and response standpoint. The specific benchmark factors used in the availability of warnings analysis are:

Warnings Available, indicating that the nature of the hazard is such that warning of the hazard event is always available (100% of the time) and received in a timely manner;

Warnings Sometimes Available, indicating that the nature of the hazard is such that warning of the hazard event is available most of the time (50-99% of the time) and received in a timely manner;

Warnings Generally Not Available, indicating that the nature of the hazard is such that warning of the hazard event is generally not available much of the time (less than 50% of the time) and generally not received in a timely manner;

Warnings Unavailable, indicating that the nature of the hazard is such that warning of the hazard event is not available at any time.

Benchmark factor values are:

- 1 pt. Available (100% of time)
- 4 pts. Sometimes (50-99% of time)
- 7 pts. Generally Not (,50% of time)
- 10 pts. Unavailable (0% of the time)

Mitigative Potential

Mitigative potential refers to the relative ease with which a particular hazard event can be mitigated against through the application of structural or non-structural (or both) mitigation measures. Generally, the easier a hazard event is to mitigate against, the less of a future threat it may pose to a community in terms of loss of life and property. The specific benchmark factors used in the mitigative potential analysis are:

Easy to Mitigate, indicating there are a wide variety of structural and/or non-structural measures that can be reasonably and economically applied to a particular hazard event to lessen or eliminate future vulnerability;

Possible to Mitigate, indicating there are some structural and non-structural measures that can be applied to a hazard event, but not all can be applied in an economical manner or are absolutely effective in lessening or eliminating future vulnerability;

Difficult to Mitigate, indicating that there are very limited choices for mitigating a hazard event, and not all measures may prove to be effective in lessening or eliminating future vulnerability;

Impossible to Mitigate, indicating that the nature of the hazard event is such that it is virtually impossible to effectively apply mitigation measures to lessen or eliminate future vulnerability.

Benchmark factor point values are:

- 1 pt. Easy
- 4 pts. Possible
- 7 pts. Difficult
- 10 pts. Impossible

HAZARDS PROFILE AND EVALUATION

CIVIL DISTURBANCES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	C	4	24

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts)	A	10	A. Impossible (10 pts)	C	4	A. (10 pts)		0	14

B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)			B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)			B. (7 pts) C. (4 pts) D. (1 pt)			
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TOTAL HAZARD SCORE:74

HAZARDS PROFILE AND EVALUATION

DROUGHT

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	D	1	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	27

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	B	7	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts)	C	4	A. Impossible (10 pts)	C	4	A. (10 pts)		0	8

B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)			B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)			B. (7 pts) C. (4 pts) D. (1 pt)			
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TOTAL HAZARD SCORE: 71

HAZARDS PROFILE AND EVALUATION EARTHQUAKES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	B	7	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	D	1	12

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	30

Availability of	Weight	TOTAL	Mitigative	Weight	TOTAL	Additional	Weight	TOTAL	TOTAL
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Warnings (ease with which the public can be warned of hazard)	(X)	SCORE FOR MEASURE :	Potential (ease with which hazard can be mitigated against)	(X)	SCORE FOR MEASURE :	Measure?	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	D	1	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	8

TOTAL HAZARD SCORE: 71

HAZARDS PROFILE AND EVALUATION EXTREME TEMPERATURES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	B	7	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	A	10	27

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts)	A	10	A. Unpredictable (10 pts)	B	7	A. High (10 pts) B. Good (7 pts)	C	4	21

pts) C. Two Seasons (4 pts) D. One Season (1 pt)			B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)			C. Some (4 pts) D. No (1 pt)			
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Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	B	7	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	C	4	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	11

TOTAL HAZARD SCORE: 80

HAZARDS PROFILE AND EVALUATION

FIRE HAZARDS: SCRAP TIRE FIRES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	D	1	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	12

Seasonal Pattern	Weight	TOTAL	Predictability	Weight	TOTAL	Collateral Damage	Weight	TOTAL	TOTAL
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(degree to which hazard occurs in one particular season)	(X)	SCORE FOR MEASURE :	(ease with which hazard can be predicted, in terms of time, location, magnitude)	(X)	SCORE FOR MEASURE :	(possibility of hazard causing secondary damage/impacts)	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	D	1	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	11

TOTAL HAZARD SCORE: 59

HAZARDS PROFILE AND EVALUATION

FIRE HAZARDS: STRUCTURAL FIRES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	B	7	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	18

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:

Hazard Mitigation Plan

A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	B	7	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	D	1	12
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Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)		TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	17

TOTAL HAZARD SCORE: 71

HAZARDS PROFILE AND EVALUATION
FIRE HAZARDS: WILDFIRES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	15

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	D	1	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	C	4	9

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	B	7	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	18

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	C	4	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	14

TOTAL HAZARD SCORE: 56

HAZARDS PROFILE AND EVALUATION FLOODING HAZARDS: DAM FAILURES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
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Hazard Mitigation Plan

A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	21
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Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	27

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	C	4	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	8

TOTAL HAZARD SCORE: 83

HAZARDS PROFILE AND EVALUATION
FLOODING HAZARDS: RIVERINE AND URBAN FLOODING

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	B	7	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	24

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	27

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	B	7	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts)	D	1	A. Impossible (10 pts)	C	4	A. (10 pts)		0	5

B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)			B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)			B. (7 pts) C. (4 pts) D. (1 pt)			
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TOTAL HAZARD SCORE: 80

HAZARDS PROFILE AND EVALUATION
FLOODING HAZARDS: SHORELINE FLOODING/EROSION

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	C	4	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	C	4	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	B	7	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	18

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	B	7	18

Availability of	Weight	TOTAL	Mitigative	Weight	TOTAL	Additional	Weight	TOTAL	TOTAL
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Warnings (ease with which the public can be warned of hazard)	(X)	SCORE FOR MEASURE :	Potential (ease with which hazard can be mitigated against)	ht (X)	SCORE FOR MEASURE:	Measure?	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	D	1	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	8

TOTAL HAZARD SCORE: 56

HAZARDS PROFILE AND EVALUATION HAZARDOUS MATERIAL INCIDENT: FIXED SITE

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	B	7	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	C	4	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	B	7	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	A	10	27

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7)	A	10	A. Unpredictable (10 pts)	A	10	A. High (10 pts) B. Good (7 pts)	A	10	30

pts) C. Two Seasons (4 pts) D. One Season (1 pt)			B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)			C. Some (4 pts) D. No (1 pt)			
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Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	17

TOTAL HAZARD SCORE: 95

HAZARDS PROFILE AND EVALUATION
HAZARDOUS MATERIAL INCIDENT: TRANSPORTATION

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	B	7	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	18

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	C	4	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	21

Seasonal Pattern	Weight	TOTAL	Predictability	Weight	TOTAL	Collateral Damage	Weight	TOTAL	TOTAL
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(degree to which hazard occurs in one particular season)	(X)	SCORE FOR MEASURE :	(ease with which hazard can be predicted, in terms of time, location, magnitude)	(X)	SCORE FOR MEASURE :	(possibility of hazard causing secondary damage/impacts)	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	17

TOTAL HAZARD SCORE: 80

HAZARDS PROFILE AND EVALUATION INFRASTRUCTURE FAILURES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	A	10	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	27

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:

Hazard Mitigation Plan

A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	27
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Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	B	7	21

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	D	1	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	11

TOTAL HAZARD SCORE: 86

HAZARDS PROFILE AND EVALUATION NUCLEAR ATTACK

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	18

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	A	10	30

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	30

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	B	7	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	17

TOTAL HAZARD SCORE: 95

HAZARDS PROFILE AND EVALUATION NUCLEAR POWER PLANT ACCIDENTS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:

A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	18
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Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	B	7	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	A	10	21

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	D	1	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	11

TOTAL HAZARD SCORE: 74

HAZARDS PROFILE AND EVALUATION OIL AND GAS WELL ACCIDENTS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	D	1	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	12

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts)	A	10	A. Impossible (10 pts)	B	7	A. (10 pts)		0	17

B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)			B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)			B. (7 pts) C. (4 pts) D. (1 pt)			
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TOTAL HAZARD SCORE: 65

HAZARDS PROFILE AND EVALUATION
PETROLEUM AND NATURAL GAS PIPELINE ACCIDENTS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	D	1	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	C	4	9

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of	Weight	TOTAL	Mitigative	Weight	TOTAL	Additional	Weight	TOTAL	TOTAL
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Warnings (ease with which the public can be warned of hazard)	(X)	SCORE FOR MEASURE :	Potential (ease with which hazard can be mitigated against)	(X)	SCORE FOR MEASURE :	Measure?	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	C	4	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	14

TOTAL HAZARD SCORE: 59

HAZARDS PROFILE AND EVALUATION PUBLIC HEALTH EMERGENCIES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	18

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	A	10	30

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts)	A	10	A. Unpredictable (10 pts)	C	4	A. High (10 pts) B. Good (7 pts)	C	4	18

pts) C. Two Seasons (4 pts) D. One Season (1 pt)			B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)			C. Some (4 pts) D. No (1 pt)			
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Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	C	4	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	8

TOTAL HAZARD SCORE: 74

HAZARDS PROFILE AND EVALUATION SABOTAGE/TERRORISM

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	A	10	30

Seasonal Pattern	Weight	TOTAL	Predictability	Weight	TOTAL	Collateral Damage	Weight	TOTAL	TOTAL
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(degree to which hazard occurs in one particular season)	(X)	SCORE FOR MEASURE :	(ease with which hazard can be predicted, in terms of time, location, magnitude)	(X)	SCORE FOR MEASURE :	(possibility of hazard causing secondary damage/impacts)	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	30

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	20

TOTAL HAZARD SCORE: 101

HAZARDS PROFILE AND EVALUATION SUBSIDENCE

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	D	1	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	12

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:

Hazard Mitigation Plan

A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	C	4	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	D	1	9
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Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	A	10	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	17

TOTAL HAZARD SCORE: 62

HAZARDS PROFILE AND EVALUATION THUNDERSTORM HAZARDS: HAIL

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	24

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	C	4	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	D	1	9

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	B	7	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	C	4	18

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	14

TOTAL HAZARD SCORE: 65

HAZARDS PROFILE AND EVALUATION THUNDERSTORM HAZARDS: LIGHTNING

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:

A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	A	10	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	27
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Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	B	7	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	C	4	15

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	B	7	18

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	14

TOTAL HAZARD SCORE: 74

HAZARDS PROFILE AND EVALUATION THUNDERSTORM HAZARDS: SEVERE WINDS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	A	10	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	27

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	C	4	24

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	A	10	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	24

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts)	C	4	A. Impossible (10 pts)	A	10	A. (10 pts)		0	14

B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)			B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)			B. (7 pts) C. (4 pts) D. (1 pt)			
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TOTAL HAZARD SCORE: 99

HAZARDS PROFILE AND EVALUATION
THUNDERSTORM HAZARDS: TORNADOES

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	A	10	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	C	4	24

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	B	7	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	B	7	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	A	10	24

Availability of	Weight	TOTAL	Mitigative	Weight	TOTAL	Additional	Weight	TOTAL	TOTAL
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Warnings (ease with which the public can be warned of hazard)	(X)	SCORE FOR MEASURE :	Potential (ease with which hazard can be mitigated against)	(X)	SCORE FOR MEASURE :	Measure?	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)		10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	14

TOTAL HAZARD SCORE: 83

HAZARDS PROFILE AND EVALUATION AIR, LAND AND WATER TRANSPORTATION ACCIDENTS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	A	10	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	D	1	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	A	10	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	C	4	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	C	4	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	D	1	9

Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts)	A	10	A. Unpredictable (10 pts)	A	10	A. High (10 pts) B. Good (7 pts)	C	4	24

pts) C. Two Seasons (4 pts) D. One Season (1 pt)			B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)			C. Some (4 pts) D. No (1 pt)			
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Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	A	10	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	A	10	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	20

TOTAL HAZARD SCORE: 74

HAZARDS PROFILE AND EVALUATION
SEVERE WINTER WEATHER HAZARDS: ICE AND SLEET STORMS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	C	4	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	21

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	B	7	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	B	7	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	21

Seasonal Pattern	Weight	TOTAL	Predictability	Weight	TOTAL	Collateral Damage	Weight	TOTAL	TOTAL
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(degree to which hazard occurs in one particular season)	(X)	SCORE FOR MEASURE :	(ease with which hazard can be predicted, in terms of time, location, magnitude)	(X)	SCORE FOR MEASURE :	(possibility of hazard causing secondary damage/impacts)	(X)	SCORE FOR MEASURE :	SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	C	4	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	B	7	15

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	11

TOTAL HAZARD SCORE: 68

HAZARDS PROFILE AND EVALUATION

SEVERE WINTER WEATHER HAZARDS: SNOWSTORMS

Historical Occurrence (frequency of event)	Weight (X)	TOTAL SCORE FOR MEASURE :	Affected Area (size of geographic area impacted)	Weight (X)	TOTAL SCORE FOR MEASURE :	Speed of Onset (warning time)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Excessive (10 pts) B. High (7 pts) C. Medium (4 pts) D. Low (1 pt)	A	10	A. Large Area (10 pts) B. Small Area (7 pts) C. Multiple Sites (4 pts) D. Single Site (1 pt)	A	10	A. Minimal/No (10 pts) B. > 12 Hours (7 pts) C. 12-24 Hours (4 pts) D. < 24 Hours (1 pt)	B	7	27

Population Impact (# of casualties)	Weight (X)	TOTAL SCORE FOR MEASURE :	Economic Effects (monetary damage losses incurred)	Weight (X)	TOTAL SCORE FOR MEASURE :	Duration (time period hazard is actively present and causing damage)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:

Hazard Mitigation Plan

A. High [10+] (10 pts) B. Medium [6-10] (7 pts) C. Low [1-5] (4 pts) D. None (1 pt)	B	7	A. Significant (10 pts) B. Medium (7 pts) C. Low (4 pts) D. Minimal (1 pt)	A	10	A. Long (10 pts) B. Medium (7 pts) C. Short (4 pts) D. Minimal (1 pt)	B	7	24
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Seasonal Pattern (degree to which hazard occurs in one particular season)	Weight (X)	TOTAL SCORE FOR MEASURE :	Predictability (ease with which hazard can be predicted, in terms of time, location, magnitude)	Weight (X)	TOTAL SCORE FOR MEASURE :	Collateral Damage (possibility of hazard causing secondary damage/impacts)	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Year-round (10 pts) B. Three Seasons (7 pts) C. Two Seasons (4 pts) D. One Season (1 pt)	C	4	A. Unpredictable (10 pts) B. Somewhat Un. (7 pts) C. Predictable (4 pts) D. Highly Predict. (1 pt)	C	4	A. High (10 pts) B. Good (7 pts) C. Some (4 pts) D. No (1 pt)	B	7	15

Availability of Warnings (ease with which the public can be warned of hazard)	Weight (X)	TOTAL SCORE FOR MEASURE :	Mitigative Potential (ease with which hazard can be mitigated against)	Weight (X)	TOTAL SCORE FOR MEASURE :	Additional Measure?	Weight (X)	TOTAL SCORE FOR MEASURE :	TOTAL SCORE FOR THESE 3 MEASURES:
A. Unavailable (10 pts) B. Generally Not (7 pts) C. Sometimes (4 pts) D. Available (1 pt)	C	4	A. Impossible (10 pts) B. Difficult (7 pts) C. Possible (4 pts) D. Easy (1 pt)	B	7	A. (10 pts) B. (7 pts) C. (4 pts) D. (1 pt)		0	11

TOTAL HAZARD SCORE: 77

Summary of Risk/Severity Analysis

Upon completion of the Advanced Hazards Profile and Evaluation, using the evaluating measures and benchmark factors stated earlier, the following ten hazards presented the greatest potential for disaster in Macomb County:

1. Sabotage/Terrorism
2. Thunderstorm Hazards: Severe Winds
3. Hazardous Material Incident: Fixed Site
4. Nuclear Attack
5. Infrastructure Failures
6. Thunderstorm Hazards: Tornado
7. Flooding Hazard: Dam Failure
8. Flooding Hazard: Riverine and Urban Flooding
9. Extreme Temperature
10. Hazardous Material Incident: Transportation

The science of probability must be considered when rating potential for the occurrence and threat of a hazard. The following five hazards present the greatest potential for disaster within Macomb County when considering “most-probable” to occur:

1. Sabotage/Terrorism
2. Thunderstorm Hazards
3. Hazardous Material Incidents
4. Infrastructure Failures
5. Flooding Hazards

Hazard Mitigation Goals and Objectives

The mission of the Macomb County Hazard Mitigation Plan is to protect the health and safety of the public and property of the community by taking action to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards.

In order to accomplish that mission, specific goals and objectives have been established. These goals and objectives are based on the county's hazard analysis, as well as input from the public, home and business owners, community organizations, and other interested entities.

Goals and Objectives for 2002-2007

Goal 1: Increase local participation in hazard mitigation.

- A. Encourage cooperation and communication between urban planning and emergency management officials in local county communities.
- B. Encourage local agencies, such as the fire, police, planning, and building departments, to participate in the hazard mitigation process.
- C. Encourage public and private organization participation.
- D. Encourage communication between emergency managers and the Local Emergency Planning Committee.

Goal 2: Integrate hazard mitigation considerations into the community's comprehensive planning process.

- A. Enforce hazard provisions in local building codes.
- B. Incorporate hazard mitigation into basic land use regulation mechanisms.
- C. Update of zoning ordinances to reflect new building code and shoreline protection rules.
- D. Develop code enforcement and zoning ordinances in urban/wildland intermix areas.
- E. Incorporate hazard area classifications into standard zoning classifications.
- F. Adopt urban forest management plans or ordinances.
- G. Develop community warning systems in areas of the county not presently covered.
- H. Strengthen anchoring requirements for propane tanks and hazardous material tanks in the floodplain/floodway.
- I. Strengthen the role of the Local Planning Committee in the land development process.
- J. Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas.
- K. Integrate hazard mitigation into the community's planning enabling legislation.

Goal 3: Apply available resources to hazard mitigation.

- A. Provide a list of desired community mitigation measures to the State of Michigan for possible future funding.
- B. Encourage the county Road Commission to review roads, bridges, and related transportation infrastructure for hazard vulnerability.
- C. Encourage private business involvement in hazard mitigation projects.

Goal 4: Increase public awareness of hazard mitigation.

- A. Increase awareness of hazard provisions in local building codes.
- B. Increase awareness of the National Flood Insurance Program.

Goal 5: Complete all hazard mitigation projects as scheduled.

- A. Reduce losses associated with the Clinton River flooding by purchasing property on Kerner Street.

- B. Reduce losses associated with the Clinton River flooding by purchasing a residential unit and vacant property on Edgewater Drive (Moravian Manor).
- C. Reduce losses associated with Coon Creek and Deer Creek Watersheds by raising homes out of the floodplain.

Identification of Alternatives for Solving Problems

The County of Macomb used a variety of sources in developing a range of potential solutions for solving identified problems associated with the various hazards addressed in this plan.

First, a series of brainstorming sessions were held to solicit ideas and suggestions from local public officials, citizens, home and business owners, community organizations, the county planning department, the state and federal government (See Public Involvement). At these meetings, suggestions were made on possible ways to reduce or eliminate community vulnerability to natural and technological hazards. Those suggestions were grouped by hazard type. Then, a screening committee comprised of local emergency managers from the cities of Warren, Sterling Heights, Fraser, and the Township of Clinton went through the ideas and suggestions and filtered out those that were not compatible with the county's goals and objectives or were not technically or financially feasible. Through this screening process, only those alternatives that had a viable chance of being implemented were actually considered.

Filtering Criteria Used to Select and Prioritize Alternatives

Next, a set of filtering criteria was developed in order to determine which of the mitigation alternatives were best suited to address the identified problems within the current framework of mitigation programs and policies within the county. The following filtering criteria were used to select and prioritize alternatives for this plan:

Filtering Criteria

- The cost of the measure must be less than the cost of repetitive repairs that would be necessary if the measure were not implemented.
- The measure must be acceptable to those participating and/or primarily impacted.
- The measure must be affordable to all it affects, and not discriminate against those who are unable to bear the cost.
- The measure must not result in an inequitable distribution of essential public services.
- The measure must be environmentally sound and not cause any permanent, significant environmental concerns.
- The measure must technically be feasible.

County decision-makers then reviewed the list of alternatives against the established filtering criteria to come up with the list of the most desired alternatives for each county goal.

Recommended Mitigation Actions

The following recommended actions are selected for the goals and objectives that were presented earlier in the plan. Each recommended action is addressed similarly and includes the following analysis components:

- Description of the problem
- Description of the action
- Lead manager assigned
- Schedule to initiate action
- Potential sources of technical assistance
- Potential sources of financial assistance

1. Reduce losses associated with the Clinton River flooding.

1.1 Reduce flood losses to the fullest extent possible.

1.1.1. Description of the problem: The floodway is the most dangerous and destructive portion of the floodplain. The floodway is intended to carry the entire 100-year flood without increasing the flood height by more than 1/10 of a foot. The floodway has the most stringent development and building regulations within the floodplain. This is a potentially harmful location for a building, because state and local codes make it difficult to repair, expand, or replace existing structures. All efforts should be made to clear the floodway of obstructions and maintain the floodplain in an "open state." This will also clear the property adjacent to the river so that it can be reused as a contiguous riverfront recreation area.

1.1.2 Description of the Action: Establish a voluntary acquisition program of floodway properties based on Fair Market Value. Retain in public ownership and rezone as a conservation area.

1.1.3 Lead Manager(s) Assigned: A team consisting of the Macomb County Emergency Management Coordinator and local community officials, reporting to the local government, to manage the entire plan implementation effort.

1.1.4 Schedule to Initiate Action: Initiate Flood Mitigation Assistant Grant Program application by July 1, 2000, and resubmit, if necessary, following every Presidential Disaster Declaration with the State of Michigan. Completion of acquisition of property should be accomplished within one year of receiving funding.

1.1.5 Potential Sources of Technical Assistance: State Hazard Mitigation Program, State NFIP Program, Michigan Stormwater-Floodplain Association.

1.1.6 Potential Sources of Financial Assistance: FMA, HMGP, CDBG, Clean Michigan Initiative, and USACE Challenge 21 Program.

Project 1

Adjacent properties to Frank H. Budd Park have been targeted for acquisition to complete an assembly of properties. Properties have been acquired utilizing the Township General Fund, Community Development Block Grant (CDBG) Program and the Michigan Natural Resources Trust Fund Grants.

These proposed acquisitions include four small lots located in Riverside Gardens Subdivision. Initially, the CDBG Program was utilized to relocate families because of severe flooding. These lots are vacant and within the 100-year floodway of the Clinton River. This acquisition would accomplish acquisition of the entire subdivision by Clinton Township and vacating of an unnecessary public road (Kerner Street). In addition, it would complete the expansion of Frank H. Budd Park that would include contiguous properties without non-township owned land surrounded by the park. The estimated appraised value is \$76,000.00 with incidental costs of \$24,000.00. The incidental costs include the possible removal of old house foundations, debris, and septic tanks. The lead manager for this project would be the Director of Community Planning for Clinton Township. This property would be used only for public recreation (See Appendix A).

Project 2

Public acquisition and management of lands that are vulnerable to damage from flooding hazards. Properties that have been identified in the Moravian Manor subdivision are located within the 100-year floodplain (Zone AE). The Base Flood Elevation Line is 593 feet. A residential unit, which is exposed to a severe flooding hazard, has been identified, and the owner has agreed to sale at fair market value. The total amount of acreage is 2.752 acres, with an estimated appraised value of \$102,000.00. Estimated incidental costs (appraisal fees) total \$8,000.00. The total acquisition costs for the vacant lots and one residential unit is estimated at \$110,000.00. The lead manager for this project would be the Director of Community Planning for Clinton Township (See Appendix B).

Project 3

The analysis, conducted by the Michigan Department of Environmental Quality, notes about 20 to 25 houses that may be currently within the 100-year floodplain. The Flood Mitigation Assistance Program and the Hazard Mitigation Grant Program both may be used to purchase, relocate, or flood-proof homes that are prone to flooding. The county's Emergency Management Coordinator and the local township supervisor have been identified as the lead manager for this project.

Project Four

Harrison Township has identified three residential units that have had repetitive losses from flooding. It is recommended that these residential units be raised above the floodplain. The estimated values of these homes exceed \$300,000.00. The costs to elevate these homes, that are structurally sound, have been estimated at \$24,000.00. A cost/benefit analysis would justify elevating rather than the removing these residential units. The Public Works Supervisor has been identified as the lead manager for this project.

Project Five

Harrison Township has identified property adjacent to the Clinton River Spillway that is located within the 100-year spillway. This project would help clear the floodway of obstructions and maintain the floodplain in an open state. This will also allow the property to be used as a contiguous riverfront recreation area. The projected costs for this property is estimated at \$60,000.00. Development of property adjacent to this site is presently occurring. Purchase of property located in the floodplain will reduce the amount of water entering the Clinton Watershed, thus

mitigating flood hazards for Harrison Township. The Public Works Supervisor has been identified as the lead manager for this project.

Project Six

Clinton Township is developing a Geographic Information System (GIS) for disaster mitigation and emergency response planning. Clinton Township plans to use the system for identifying flood plain areas prone to natural flooding, surface water modeling for flood control and storm water management and identifying the spatial relationships between residential, special populations, potential hazards, and emergency services. The cost for this system has been estimated at \$20,000.00. The lead manager for this project would be the township's local emergency manager.

Project Seven

The townships of, Harrison, Chesterfield, and the City of Fraser have identified problems with their pump stations. During periods of heavy rains, sanitary sewage is allowed to enter the storm sewers. These storm sewers enter into the Clinton Drain and then into Lake St. Clair which relates to health and safety issues at hand. If this sewage is not permitted to go to the storm sewer, the basements of the residents in the area will flood. The estimated cost to upgrade these facilities has been estimated to be \$100,000.00. The Water Department Supervisors for the respective communities would be the lead managers.

2. To Increase the County's Hazardous Materials Response Capabilities.

2.1 To improve the capability of local governments to respond to hazardous material incidents at fixed sites and transportation incidents involving hazardous materials.

2.1.1. **Description of the problem:** Over the past few decades, new technologies have developed at a stunning pace. As a result, hazardous materials are present in quantities of concern in business and industry, agriculture, colleges, hospitals, utilities, and other facilities in Macomb County.

2.1.2 **Description of the Action:** Provide a hazardous materials response team for north and central Macomb County.

2.1.3 **Lead Manager(s) Assigned:** A team consisting of the Macomb County Emergency Management Coordinator and the Shelby Township Fire Department, to manage the entire plan implementation effort.

2.1.4 **Schedule to Initiate Action:** Initiate grant applications by May 1, 2000, and resubmit following every Presidential Disaster Declaration with the state of Michigan. Completion of project should be accomplished within one year of receiving funding.

2.1.5 **Potential Sources of Technical Assistance:** Michigan State Police Emergency Management Division.

2.1.6 **Potential Sources of Financial Assistance:** State Hazard Mitigation Program.

3. Reduce the Effects of Severe Weather To the County's Infrastructure System.

3.1 Reduce disaster-related damage to electric power facilities and systems..

3.1.1. **Description of the problem:** Severe weather in Macomb County has resulted in damage to the county's electrical infrastructure. The community most effected has been St. Clair Shores.

3.1.2 Description of the Action: Increase funds to a program that will focus on trimming trees to prevent encroachment of overhead lines.

3.1.3 Lead Manager(s) Assigned: A team consisting of the Macomb County Emergency Manager and the St Clair Shores Parks and Recreation Superintendent, to manage the entire plan implementation effort.

3.1.4 Schedule to Initiate Action: Initiate grant applications by May 1, 2000, and resubmit following every Presidential Disaster Declaration with the state of Michigan. Completion of project should be accomplished within one year of receiving funding.

3.1.5 Potential Sources of Technical Assistance: Michigan State Police Emergency Management Division.

3.1.6 Potential Sources of Financial Assistance: State Hazard Mitigation Program.

Project One

This project will focus on trimming trees to prevent encroachment of overhead lines. The project manager will conduct a survey and identify trees that if damaged by severe weather may cause infrastructure failure. This project has been estimated to cost \$20,000.00

Flood Mitigation Assistance (FMA) Focus Section:

A Detailed Analysis of Macomb County Flood Hazards

Introduction

There are several types of flooding that occur in Macomb County. Since Macomb County is adjacent to Lake St. Clair, it sometimes experiences damaging flood events from shoreline flooding and storm surges. This type of flooding shall be referred to as **shoreline flooding**. Macomb County has numerous rivers and creeks, and an extensive drainage system, and many flood events take place near these water channels, as their normal capacity is exceeded. This type of flooding will be referred to as **riverine flooding** in this document. Such flooding is sometimes due merely to occasional natural patterns of unusually heavy precipitation and snowmelt. In other cases, rivers and drains have had their drainage capacities lowered over time with the build-up of sediment and debris, which can be very expensive to clear away. In addition, increasingly urban land uses have caused increases in the amount and speed of surface water that runs off into these drains and channels. While they used to be adequate, they now tend to overflow their banks more frequently. Another source of flooding shall be called **urban flooding**, which concerns events caused by flaws or inadequacies of storm and sanitary sewer systems. In some cases, water merely pools in low-lying areas where no sewers have been installed. In other cases, sewers are present, but due to limited capacity of the system, the surface water depths in that area continue to rise and eventually becomes hazardous. When the capacity of the sanitary sewers in some areas is exceeded, sewage may flow back up the pipes into people's homes, causing damages and health concerns. Failures at pumping stations may also be a cause of this sort of flooding. Some sewer systems in the county are burdened by illicit or inappropriate connections of downspouts, footer drains, or other sources of runoff water. Some areas still have combined rather than separated storm and sanitary sewer systems, whose capacities are more easily overwhelmed during rain and storm events. In other cases, drains that are meant to empty into Lake St. Clair will not do so during some periods of high lake levels, storm surges, or wind and wave activity.

Historical Background and Current Conditions

Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for serious flooding because rainfall that used to soak into the ground or take several days to reach a river or stream

via a natural drainage basin now quickly runs off streets, parking lots, and rooftops, and through man-made channels and pipes. The amount of water flowing through these channels will therefore tend to increase and overflow into surrounding areas as its quantity increases, flooding lands that are normally dry. Flooding may not necessarily be directly attributable to a river, stream or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall and/or snowmelt, saturated ground, and inadequate drainage. The water, with no place to go, will find the lowest elevations, areas that are often not in a floodplain. That type of flooding is becoming increasingly prevalent in Macomb County, as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. Many flood fatalities occur due to people attempting to travel through flooded areas, either by car or on foot. A foot of flowing water may sweep a car off a road, and drivers will also be unable to see if the road beneath the floodwaters is still intact. Portions of it may have eroded or broken away, manhole covers may have been displaced, and live power lines may be in the vicinity of the flooding. Debris flowing along with floodwaters can easily damage vehicles and trap or injure persons in their path, increasing risks of drowning. Collateral dangers from flooding include the outbreak of disease, widespread animal death, broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fires, the collapse of weakened structures, and the release of hazardous materials.

Flood-prone areas are found throughout the county, as every lake, river, stream and county drain may have a floodplain. The type of development that exists within the floodplain will determine whether flooding will cause damage. This "focus section" of Macomb County's hazard mitigation plan will provide a detailed assessment of its flood-prone areas, based on government data and mapping sources, and input from representatives of all jurisdictions in the county (except in the cases of Grosse Pointe Shores and Memphis, which are covered by the emergency management programs of adjacent counties, even though portions of them are located in Macomb County). The Michigan Department of Environmental Quality has estimated that about 6% of Michigan's land is flood-prone, including about 200,000 buildings, and that the southern half of the Lower Peninsula, where Macomb County is located, contains the areas with the most flood damage potential. Steps have been and are currently being taken to mitigate flood impacts on people, property, business, travel, and quality of life. This section of the hazard mitigation plan will suggest areas of need, where actions should be performed to further mitigate flood damages.

The primary flooding sources include Lake St. Clair, the different branches of the Clinton River, hundreds of miles of streams, creeks, drains, and inland lakes. Flooding is not restricted to the main branches of the river. The Lake St. Clair shoreline and the Clinton River watershed have some of the most

significant damage potential in the state, which this plan will address. Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Ice jams also cause flooding in winter and early spring. Severe thunderstorms may cause flooding during the summer or fall, although these are normally localized and have more impact on watercourses with smaller drainage areas. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious health and safety concerns. In Macomb County, numerous communities have experienced this type of problem, and more detail on it will appear later in the text.

Macomb County is ranked number one of all Michigan counties in flood insurance coverage. Harrison Township (1), St. Clair Shores (2), and Chesterfield Township (7) are in the top ten of Michigan communities for flood insurance coverage. Harrison Township (2) and St. Clair Shores (3) are listed in the top ten of Michigan communities in the number of flood insurance policies. Most communities in the county are participants in the National Flood Insurance Program (NFIP). Even in the inland and rural northern areas, the Village of Armada, Ray Township, and Lenox Township participate in the National Flood Insurance Program (although there are only two flood insurance policies currently in force). The Township of Armada has recently joined the NFIP. Communities not listed as NFIP members are Richmond Township and the cities of Richmond and Eastpointe, and the Village of Romeo. As a result, flood insurance is not available in those areas although in some cases they are vulnerable to certain types of flooding.

Macomb County has a historical record of severe windstorms, thunderstorms, tornadoes, winter snowstorms and heavy rainfalls that have led to flooding.

- In February 2001, thawing snow and runoff waters combined with rain to cause flooding as the Clinton River backed up in some spots. The worst effects of this were felt around North Avenue from Hall Road to 26 Mile Road, but some other areas in the county were affected as well.
- In July and September of 2000, two to three hundred houses in the south of the county experienced basement flooding as a result of heavy rain events.
- In May 1998, shoreline flooding occurred and damaged residential structures. Water levels in Lake St. Clair are currently (in 2001) well below average, providing a window of opportunities for mitigating future shoreline flood events.
- In February 1998, an early winter thaw coupled with an unusually high rainfall caused numerous communities to experience flooded homes and waterways.
- In 1997, unusually high water levels in Lake St. Clair resulted in the initiative "*Flood Fight 1997.*" In July of the same year, Macomb was included in a Presidential Disaster Declaration for five Michigan counties

that had been affected by flooding and wind damage from a series of intense thunderstorms.

- In May of 1997, Harrison Township experienced severe flooding in the Willow Point Mobile Home Park.
- In June of 1996, Harrison Township experienced severe flooding in the Willow Point Mobile Home Park.
- In August 1995, there was major flooding due to heavy rains, including cars totally submerged on freeways.
- In January 1993, an early thaw due to unusually warm weather combined with heavy rains resulted in major flooding problems.
- In February 1986, a Governor's Declaration was issued due to flooding of the Great Lakes and Lake St. Clair.
- In September 1986, a Presidential Emergency Disaster was declared due to major flooding.
- In April 1985, a Governor's Declaration was declared due to flooding on Lake St. Clair.
- In October 1981, there was major flooding in the county due to heavy rains—SBA loans were made available.
- April 1975, a Presidential Emergency Disaster was declared due to rain, flooding, and tornadoes.

The County now seeks to use the Flood Mitigation Assistance Program to fund mitigation projects to alleviate future damages from this hazard. Current risk conditions are described and prioritized in the following parts of this document.

Warning Systems

Presently, Macomb County relies on the National Weather Service for flood warning. Historically, Macomb County has suffered shoreline flood damages during periods of high lake levels, which allows communities time to anticipate mounting risks and undertake actions to alert residents. Urban flooding, due to storm sewer backup, has a shorter preparedness time factor. The National Weather Service will issue flood watches and warnings when conditions are right for such events, and this information is then relayed to residents throughout the area, using radio, television, cable, and computer media.

Mitigation Priorities

Riverine and urban flooding was rated as the number one hazard for the following communities:

- Chesterfield Township,
- Clinton Township,
- Eastpointe,

- Fraser,
- Harrison Township,
- Macomb Township,
- Mt. Clemens,
- New Baltimore,
- Roseville,
- St. Clair Shores, and
- Utica

Most of the communities are proactive in mitigating flood problems, within the limits of their resources. In general, new developments throughout the county require retention and detention facilities to reduce the effects of heavy rainfalls in flood-prone areas, and so the current problems tend to be with older structures that were less carefully engineered against flood threats when they were built. Encouragement must be given to developing areas, such as the county's northern communities, to carefully avoid building structures in flood plains and use flood plain areas for recreational use, as in Sterling Heights, and the townships of Macomb and Clinton. Public purchases of property, while it is still undeveloped and relatively low-priced, is also critical at this time to mitigate the flood hazard in many areas. Special efforts are needed to help residents of Harrison Township and other areas with funds to elevate homes out of the flood plain. Efforts of local communities toward mitigating flood damage should be recognized, with the realization that much can still be done to reduce the damages and dangers caused by floods to an even lower level. Detailed maps and discussion of identified risk areas will be given in this plan for all areas of significant risk throughout the county.

Although it may be extremely difficult in some cases to state definitively that some areas are of greater or lesser concern than others, a general classification scheme has been followed in which **highest priority** mitigation actions are assumed to be those involving structures that have repeatedly suffered flood damages according to the NFIP. **Second priority** would be structures that are known to have suffered from flooding, and are clearly in a floodplain area. The **third priority** has been assigned to structures that have been determined to be in the 100-year flood plain, but for which no damages have been reported to local authorities. **Last in priority** but still worthy of consideration are structures that are in areas of less than a 1% of flooding each year, such as in a 300 or 500-year flood plain area. Included in this category are those in areas that may be prone to basement flooding from sewer back-ups, but only when there is no basis for predicting which homes in the urban area will experience this problem. Structures deemed to have lesser risks than those outlined in these categories have not been considered in this plan.

In terms of affected infrastructure, major highways that become temporarily impassable from floodwaters, and threatened facilities that are critical to an area's infrastructure will be given **highest priority**. **Second priority** would be locally important roads that become temporarily impassable, or suffer substantial damage from flooding, or major highways that have traffic significantly impeded by floodwaters. **Third priority** in this category would be minor roads

that are temporarily impassable or suffer damages from flooding, or locally important roads that have traffic significantly impeded by floodwaters. **Last in priority** but still worthy of consideration would be local roads that experience flooding but are not impassable, and flood areas that are a local nuisance but do not have clear damages that would make them a higher priority, by FMA standards. Many incidents of local street and yard flooding would fall into this lowest-priority category, in terms of countywide flood mitigation priorities.

Methods for Assessing and Prioritizing Flood Hazard Areas

Although broad levels of priority were described in the preceding section, it is necessary to subdivide these categories still further to identify which specific areas and projects are most meritorious to implement in the near future, using the Flood Mitigation Assistance Program (FMAP). Since FMAP money comes from the National Flood Insurance Program (NFIP), it was essential to identify as **highest priority** those NFIP-*insured* structures that have suffered repeated property damages to reduce continued financial drains on these public funds. Properties that have suffered known damages were assessed as **second priority**, but these will be further analyzed in a later section (starting on page 33) to estimate whether they are located in NFIP-identified floodplain areas and what depths of flooding they are experiencing. Hazard-prone areas will be ranked according to these factors, favoring official floodplain locations over unofficially identified flooding areas, and favoring greater flood-depth areas over lesser flood-depth ones. **Third priority** hazard areas, and **last in priority** areas are not given precise priorities in this document. Such projects will be examined either after the mitigation of **first priority** and **second priority** ones in a future plan revision, or after a Letter of Map Amendment (LOMA) is submitted to officially adjust the floodplain designation of the area on the NFIP's Flood Insurance Rate Map (FIRM).

This FMA focus section of the Macomb County Hazard Mitigation Plan was written by a professional planner after extensive meetings with local and Macomb county officials between March and September 2001. These meetings involved Macomb County Emergency Management, Macomb County Public Works, and various officials from the cities of Fraser, Roseville, St. Clair Shores, Sterling Heights, Utica, Mt. Clemens, Warren, Center Line, New Baltimore, Eastpointe, and Richmond. Local officials were also met with to discuss the concerns and conditions in the townships of Clinton, Macomb, Harrison, Chesterfield, Bruce, Shelby, Armada, Ray, Lenox, Richmond, and Washington, thus covering all political units that are completely located in Macomb County and thus covered by their Emergency Management program. The discussions of township conditions also tended to cover any associated villages that were situated within township borders. Feedback was also obtained from the Village of New Haven, and all of this information was shaped into a draft version of this current document, focusing on the county's flood hazards. The draft version of this FMA Focus

Section was then reviewed by officials at the county, state, and federal level, and revised in October and November of 2001 in accordance with their suggestions.

Overview of Flood Priorities in Macomb County

NFIP Repetitive Loss Properties (highest priority)

Properties identified as "repetitive loss structures" are to be targeted for elevation, relocation, or acquisition with very high priority by the county. Damages and risks to these properties have been sufficient that the cost-effectiveness of these mitigation projects is clear, and federal funding has been made available with which to implement them.

The addresses, loss information, and structural values of identified NFIP repetitive loss properties in Macomb County, with information on observed water depths at that location, are included only as a special appendix following *some* copies of this plan, to be used only for official planning information. It was agreed that this specific information would be kept confidential to preserve the privacy of involved residents and landowners.

Some NFIP-identified Repetitive Loss Properties in Macomb County have already been moved or removed. Communities in Macomb County are presently purchasing homes and property to remove flood-prone structures and return the property back to a natural state to be used as parks and green space. Purchase of property located in the floodplain will reduce damages and injuries from flooding, and help slow water flows in area watersheds, thus helping to mitigate broader flood hazards for Macomb County.

Properties with Locally Confirmed Flooding Damages (second priority)

Although not appearing on the NFIP list of repetitive loss structures, many houses and buildings have been identified as having suffered significant damages from flooding. Most of these are located in 100-year flood plain areas, as identified on local Flood Insurance Rate Maps (FIRMs), but others were identified solely through the first-hand knowledge of local emergency management personnel, fire chiefs, public works officials, and others with direct knowledge of community flood impacts. These properties that have been known to suffer damages from flooding will be identified on maps and/or in detailed text descriptions for each community in the county. Where known, the depth of floodwaters will also be reported. Also listed as second priority will be properties identified as being at greater risk from flooding than merely the base flood rate. See the section starting on page 33 for a more detailed assessment of these conditions and priorities.

Floodplain Properties Without Known or Reported Damages (third priority)

Many structures have been identified from Flood Insurance Rate Maps and Michigan Department of Environmental Quality data as being located within a 100-year floodplain, but which apparently have not had damages that local officials are aware of. Some of these structures may be safe from flooding due to

their elevations, or the presence of flood walls or berms, but are still noted as at-risk, and are bound to experience at least some inconvenience during major flood events. Other structures may have suffered damages in the past that have been forgotten about as different persons assume ownership, or as local officials are replaced by others who may not have been aware of these events.

Properties Designated as Less Than 1% Annual Flood Risk (last in priority)

The risk of flood damaged structures in these areas should not be entirely discounted, since *low* risk should not suggest *no* risk. Also, aspects of risk may change over time, such as when upstream development speeds runoff rainwaters into area drains and rivers such that their past capacities are exceeded. There have been numerous reports of structures in "lesser-risk" areas that have suffered significant damages and inconveniences as a result of shoreline flooding. Many shoreline areas that technically were considered lower-risk have been classed in this report as being at least in 100-year floodplain areas, when the assessments of local officials indicated that this was warranted. This was also the case because some of the definitions of the risk classifications on floodplain maps seemed to warrant a higher classification in this document.

Infrastructure

It is suggested that, for those roads that may be critical to health and safety, alternative routes are determined in advance of flooding conditions.

Two public facilities have been identified in Harrison Township that are located in flood-prone areas—Harrison Fire Station 2 and St. John's Hospital. The township is planning to build a new fire station out of the flood plain area, and St. John's Hospital (which is not a primary care facility) is developing evacuation plans to remove their ambulatory patients if it ever becomes necessary to do so.

Priorities for road flooding were based on the physical characteristics of the road (number of lanes, type of surface), designations of highway status (state highway, arterial road, collector, or local road), and estimated average traffic counts, as made available from Southeast Michigan Council of Governments (SEMCOG) data. Highways of top priority typically carry more than 20,000 vehicles per day, arterial roads somewhat less. Roads of mainly local importance (collectors) typically average only a few thousand vehicles per day, and local roads tend to have well under 2,000 vehicles using them per day. When classifying road-flooding hazards for priority, it was also necessary to consider whether water depths were sufficient to cause road closure and stuck vehicles, or merely slowed traffic. The amount of time that flooding affected the road was also considered—whether observed flooding was only a temporary and unusual situation, or was more enduring and repetitious in that area and therefore representative of ongoing risks.

Detailed Reports by Community Areas

Armada Township and Village of Armada

No NFIP floodplain map is yet available for the township, so information for that jurisdiction was based primarily on interviews with local officials, and on a 1999 study of the Coon Creek and Deer Creek watersheds, researched by the Michigan Department of Environmental Quality. The Armada township and village area has the Coon Creek and its branches running through it, and these communities have noticed that increased levels of runoff into this creek and its connecting drains are leading to some new and increasing flooding problems, most notably to a house near the center of town where water ponding in the yard is now coming right up to the back of the house during rainy weather conditions. (second priority) Such problems are also increasing due to debris and sediment that have collected in area drains and waterways over the years.

In the village of Armada, a bridge on the north side of town was rebuilt in the early 1990s. This seems to have alleviated the risk to two homes to its east that otherwise appear to be located in the 100-year floodplain (township section 24). A house that appeared to be in the floodplain on maps was considered to have much lower-risk due to its elevation. A nursing home that appeared to be partially situated in a floodplain area was also currently considered to have no pressing problems. A sewage disposal plant structure also appears to be in the floodplain, but no problems of flood damage were known to officials. (All of these latter cases are in township section 23.)

Just north of the Village of Armada, in township section 14, the East Branch of the Coon Creek has been flooding over North Avenue and into homeowners' front yards, approaching their houses. Such waters have been damaging to driveways and yards. They also threaten at least one private bridge crossing over the creek. At the intersection of North Avenue and Dayton Road, just south of these houses, the depth of the water over the roadway is about half a foot. The creek continues to the southeast of this intersection. On the creek's east side, to the west of the High School (in township section 13), about five houses appear to be in its 100-year floodplain.

A couple of miles farther north, in township section 1, a culvert passes under North Avenue leading to the East Branch Coon Creek. The culvert cannot handle the capacity of runoff waters at the point, and although the houses in this area are at safe elevations, at least three property owners have large amounts of standing water in their yards.

In the west of the township, straddling township sections 7 and 8, is the Newland Drain, which has a smaller, old drain that goes under Romeo Plank Road to flow into it just southeast of Reid Road. Romeo Plank at this point suffers from water going over it. The drainage system going through this rural township needs to be cleaned out to increase its water-carrying capacity, or the flooding events described here will continue to worsen until roads and structures become damaged or inaccessible.

In the center of the township, just southwest of where the G.T.W. railroad crosses Coon Creek Road in township section 28, a house appears to be in the 100-year floodplain. However, local officials report that no damages to this house are currently known to have occurred.

In summary, in the Village and Township of Armada, there are no structures identified as NFIP repetitive loss structures, but there is one house that is at imminent risk of flood-related damages (second priority), about 7 homes and a sewage disposal plant that seem to be in the 100-year floodplain (third priority), 6 property owners who have complained about the nature of the flooding on their properties even though their homes were not involved, and a house and nursing home that may be at some risk of eventual flood damages from a major (500-year?) event (last in priority). There are also two areas with recurrent flooding over locally important roads.

Bruce Township and Village of Romeo

In this area, reported flood problems are limited to a few areas north of the Village of Romeo. Although there seem to be a few houses throughout the township that may be in a 100-year floodplain, no damages have been reported. In the far east of the township, where the Newland Drain joins the North Branch of the Clinton River and then runs alongside of 34 Mile Road, there is flooding over the roadway. Most notably, this water submerges the intersection of 34 Mile Road and Kanie Road.

A mile to the west of this, where the Mahaffy Drain crosses 34 Mile Road, the roadway similarly becomes flooded. The Mahaffy Drain needs to be upgraded to increase its capacity. There has been a residential development southwest of the intersection of 34 Mile Road and McKay Road, and the 72 new houses in that development have been the source of significantly increased runoff to that drain. As a result, there are problems every year with flooding that goes over the roadways there, and two houses on 34 Mile Road near that drain had to install sump pumps to alleviate basement flooding problems.

A mile to the northwest of this area, another area of roadway floods over repeatedly. This flooding is on M-53 (Earl Memorial Highway) in the area where the Wilson Drain originates. The highway is the most important roadway going through the township and from the Metro-Detroit area to its south. Hence it is one of the least convenient roadways on which to tolerate flood problems.

Houses that appear to be in the 100-year floodplain in maps of this area were mostly considered to be at generally lower risk except for one located southwest of where the Wilson/Mahaffy Drain crosses McKay Road. Officials agree that this house is at risk. Other structures that appeared to be in the floodplain on the maps were assessed as having a lower risk than the NFIP maps suggested, due either to the elevated nature of the buildings, or the limited precision of matching floodplain maps to USGS quad maps, which had suggested risks that did not seem as evident in field inspections of local topography, or in officials' local experiences. Damage is probably limited to yard flooding or possible basement flooding in these lower-risk cases, but eventual damages from a more severe (200-year or 500-year) event would seem to be a possibility. The number of structures that appear to be in the floodplain is as follows, sorted by township section:

- Section 1 – 2 structures (assessed as lower-risk by local officials)
- Section 5 – 1 structure (no further information known at this time)
- Section 6 – 1 structure (local officials will investigate to verify its flood risks)
- Section 14 – 3 structures (assessed as lower-risk)
- Section 18 – 1 structure (assessed as lower-risk)
- Section 22 – the one structure shown in a floodplain area on USGS maps does not exist any more
- Section 23 – 1 home in the 100-year floodplain
- Section 26 – 2 structures that have experienced basement flooding
- Section 27 – 1 structure (assessed as lower-risk)

Section 29 – 2 structures (assessed as lower-risk), plus possible street flooding east of Nowlan Lake

Section 33 – 1 structure (field-assessed as lower-risk)

Section 36 – a sewage disposal plant (no known damages from flooding)

In summary, although Bruce Township and Romeo have no identified repetitive loss structures, there are two homes that have had basement flooding problems (second priority, but mitigated by sump pumps), 3 homes and a sewage disposal plant that appear to be in a 100-year floodplain but with no known structural damages (third priority), and 10 structures that are probably within a 500-year floodplain but have suffered no known damages (last in priority). There are also three areas where road flooding regularly occurs – two of which are on locally important roads, and the last of which occurs on an important Michigan highway.

Center Line

The city of Center Line has no identified floodplain areas within it, and reports no problems with street or structural flooding. It is an NFIP member and had its combined sewer system separated in the 1970s. Downspouts have been disconnected from the new storm sewers, but footing drains are still tied to the sanitary sewer system. The city is proactive in system testing, and has been working on correcting the remaining problem of sanitary sewer overflows. During periods of very intense rainfall, it is still sometimes necessary to dump sanitary overflows so as to prevent basement flooding. The city will be trying out a pilot treatment facility for overflow waters. Environmental mitigation efforts can focus on improving the capacity of one lift station in the south of the city (sewer flows go south from the city), which can still become overloaded during major rain events.

Chesterfield Township

This jurisdiction has numerous problems needing mitigation. These are organized below into paragraphs for each section of the township. Descriptions for each section will start with the highest priority conditions and proceed to the lowest priority conditions.

Section 3 – One structure showed up on the maps as being in a floodplain. Apparently, this structure was part of a horse farm and tack shop, south of 26 Mile Road and east of Washington Road. It was reported that the house had no known problems, but the barn structure did. (third priority)

Section 6 – One home appeared to be in a floodplain south of 26 Mile Road and east of Deer Creek, but it seemed subject to flooding damages only from a 300 or 500-year event. (last in priority)

Section 9 – The Ridgewood subdivision, north of 24 Mile Road and east of Gratiot, has no reported structural damage, but gets to where water was reported as literally surrounding the houses. The main cause of this was suggested to be the nearby Crandall Drain, which, although it is currently being cleaned, still is reported to have problems handling all the water draining through it. On the other hand, the Crandall Drain was designed to act as a retention basin, 120' wide. Standing water in yards can be expected in this area, and it may be that such water has caused undue concern over long-term flood risks. (last in priority)

Section 11 – The F.O.P. Lodge building, just west of the Salt River, north of 24 Mile Road, appears to be in a floodplain area. The future use of this building apparently is uncertain, as reports are that an alternate site may later be used, with the current one taken down. (third priority)

Section 14 – Three condominium buildings appear to be located in a floodplain area just northwest of a bend in the Salt River, but it was reported that they have been designed so as to avoid flooding. (last in priority)

Section 15 – A business on the northeast corner of 23 Mile Road and Sags Road is within a floodplain area, and local officials report that its flood risks exceed those of base flood levels. (second priority) NOTE: A structure that appears on USGS maps in a floodplain area west of Fish Creek no longer exists.

Section 21 – The Meldrum Drain needs cleaning. Water from this drain is backing up and approaching homes in a neighborhood to its west, on East Shamrock Street, but as in section 9, this drain was designed to act as a retention basin. Water ponding in area yards may be misinterpreted as posing a threat that shouldn't really be of any concern in most cases. (last in priority)

Section 22 – The area where Sugarbush Road crosses the Meldrum Drain is an area of serious drainage back-up, apparently resulting from debris in the area of the bridge. Water goes over Sugarbush Road here, and right up to four nearby apartment buildings when this happens. Some local money to address this is being generated, and so there will probably be funds available to match federal grants and to perform drain cleaning. Many seniors live in that area. Three houses are located in the 100-year floodplain in this area along Callens Road, including one just west of Fish Creek. Five homes on the south side of Octavia Street are in the floodplain of the Salt River, as is one home to the west,

on Sutton Road. (third priority) There were four homes identified as being in a floodplain just east of Fish Creek, south of Callens Road, but these were evaluated as being at lower risk by local officials. Eighteen homes along Donahue and Menter Streets, near the Meldrum Drain, are in a lower-risk floodplain area. (last in priority) NOTE: A home on the south side of 23 Mile Road, east of Fish Creek, was identified on USGS quads but seemed no longer to exist in that location.

Section 23 – Two houses south of Callens Road and west of Hooker Road were identified as being in the 100-year floodplain area of the Salt River, and local officials consider these properties to be at significant risk. (second priority) Just west of the Salt River, south of 23 Mile Road, is an ice cream shop that appears to be located in a flood plain. (third priority)

Section 26 – In the area southeast of Jefferson, there are shoreline developments and numerous canals that pose flood risks to nearby homes. In the area around Schneider and Lotties Roads are about 18 homes that are scattered in various 100-year risk zones (third priority), and 50 that are in zones of lesser risk. To the north of this area, off of Miller Court, are areas that are in floodplains, but local officials advise that many of the at-risk structures here have been replaced with new homes or have been rebuilt in ways that alleviate flood problems. Probably only about a dozen homes on the shoreline side of Miller Court may now be classed as in a lower-risk floodplain area. (last in priority)

Section 27 – There is an NFIP repetitive-loss home in this area. (highest priority) Along Sugarbush Road southeast of the high school, water floods over the road and around houses, to depths of 8 to 12 inches. The houses are set higher than the adjacent grounds and so, with the help of some sandbagging, are not damaged. They are "like islands," however, and can be very difficult to access. About 36 homes in this area are affected, and the area is clearly much more hazardous than the lower-risk FIRM classification would suggest. (second priority) Shoreline flooding in this area still poses major risks. Along Harbor Drive and the lake-side of Jefferson Road, about 55 homes are in the 100-year floodplain. On the east side of the Salt River, in the Point Lakeview subdivision, 39 homes are in the 100-year floodplain. On the northwest side of the Salt River (and the northeast side of the Meldrum Drain) are some 23 homes in the 100-year floodplain. Farther inland in this area are 3 homes along Lakepointe Street, and 20 homes on Sutton Road along the south riverbank that are all in floodplain areas. About 16 homes along Killewald Street are in a floodplain. Although generally shown as a lower-risk area on the area's FIRM, officials report that the risks to these houses are probably closer to that of a 100-year floodplain. (third priority) In the Harbor Drive area, about 29 homes are in lower-risk floodplain areas, and in the Point Lakeview area, about 19 homes are in lower-risk floodplains. Nineteen homes are in lower-risk floodplain areas along Sutton Road, as are 6 homes on Lakepoint Street, 6 homes and an apartment building on Riverpoint Street, and 12 homes in the adjacent neighborhood with Jamaica and Walled Streets. The addition of the Bay Harbor pump station at Jefferson and Forbes has markedly reduced inland flooding north of Jefferson. As a result, there were about 56 homes in a 100-year floodplain area there that have had

their risks alleviated, and 27 homes that were in a lower-risk floodplain area that are now probably quite safe. This pump station was also important for the unimpeded functioning of a fire station that is located nearby. (last in priority)

Section 28 – There is an NFIP repetitive-loss home in this area. (highest priority) Southwest of Cotton Road, along the shoreline, is an area with about 13 homes that sees flooding of 6 to 8 inches from Lake St. Clair. Seventeen homes along Wand Street and the Auvase Creek are at higher risk of flooding than the 100-year floodplain indicated on the floodplain maps for that area. The homes were cottages and pumps where sandbags were needed to protect them. Dampness from water in crawlspaces and around homes doubtlessly promoted mildewing and lessening of wood integrity in some of these homes. (second priority) The 11 homes south and west of the Auvase Creek at Jefferson are in a floodplain area. Along the southern end of Forton Street are six houses in a floodplain. Two commercial structures along Jefferson just north of Wand Street are in the 100-year floodplain as well. A house at the south end of Roger Street is in the floodplain of the Auvase Creek. (third priority) Seven homes and a commercial structure are in a lower-risk floodplain around the Auvase Creek at Jefferson and Forton Street, south of Cotton Road. The northwestern portion of the Seville Manor subdivision (along Hibbs Street, Craw Street, and intersecting portions of Wright, Douglas, Salitnik, Hawk, Hoenshell, Pearl, Biallas, and North Brooks Streets) appeared from the maps to have 59 homes in the 100-year floodplain and 30 homes in the 500-year floodplain. However, due to the cleaning and expanded capacity of the drainage channel that had been causing this flooding, these homes are now considered to be outside of the floodplain, and a letter of map amendment (LOMA) is being applied to these areas. In addition, a section along this water channel to the southwest has similarly been considered to have its flood hazards successfully mitigated. This was a section along Cotton Road and including homes on Sunray, Halo, Gallus, and Dino Streets which had 14 homes in the 100-year floodplain and 17 homes in the 500-year floodplain, all of which will be covered by the LOMA. Along the shoreline northeast of Cotton Road are 10 homes that are in a floodplain but currently protected by a new dike. Just northeast of this are 5 homes in a lower-risk floodplain, and 26 homes in a floodplain area but currently protected by an earthen berm that has been put in along the shoreline. The Dykeman Drain near this area has been cleaned recently, which also reduces flood risks in this area. Thus, 10 homes that are in a lesser-risk floodplain area along Forton Road and Jefferson just southwest of this drain are probably currently well-protected from flooding. The same applies for five floodplain homes to the north of this drain, on Jefferson Road and Forbes Drive. Fifteen homes in this area that are in lesser-risk floodplains are probably quite safe for the moment. Further northeast, about 26 homes are in lesser-risk floodplain areas. (last in priority)

Section 32 – There is an NFIP repetitive-loss home in this area. (highest priority) This is an area with many problems from shoreline flooding. In the south, along the canal south of Field Street, is an area of about nine homes that are all subject to flooding during periods of high water levels in Lake St. Clair. In events in 1985 and 1986, flood waters were 6 to 12 inches deep in this area.

The Schmidt Drain flows into a canal alongside Macon Street in this shoreline area. Where this canal meets the lake waters, a party store, marina office, and gas dock are situated and have had flooding depths up to 18 inches. There are a total of 14 structures along this canal (around Teal and Macon Streets) that are in a 100-year floodplain, including the 3 just mentioned (the others being homes). In the 1970s and 1980s, these homes had 6 to 12 inches of water flooding them, and there is an NFIP repetitive-loss structure here. Pumps and sandbagging were used in the 1980s to reduce flood damages. There are seven more homes in a lower-risk flood area. The area is designated a Zone A3 floodplain. About 106 houses located east of Jefferson and south of Farwell (in addition to those already mentioned in this description) are considered at-risk. The roads and bridges in this area are privately owned and are underwater during flood events (mainly around Anchor Road.). These bridges also have low load limits, and have been weakened by past floods, so access to the entire area is severely impeded during flooding, especially for emergency vehicles. During the 1970s, many houses in this neighborhood had 2 to 4 inches of water flooding them, and sandbagging has been required to reduce damages since that time. Jefferson Avenue, the major road serving the shoreline areas, also floods over in this area. (Information from the FIRM for this area, with its "Zone B" classification, is somewhat ambiguous. These homes are probably subject to 100-year flooding of less than one foot of depth.) South of Anchor Road, flooding worsens; some basements were completely flooded in the 1970s! Many houses sit at or below road level, and both have suffered 6 to 8 inches of floodwaters. Improvements are expected from the proposed Schmidt Drain Pump House improvements. To the north of Anchor Road, sandbagging has been necessary to attempt to protect numerous structures there, comprising a party store, laundromat, and 17 homes, which are all in a floodplain area. (second priority) In the neighborhood to the north of Farwell Street are three homes in 100-year floodplain areas. About 39 homes appear to be in a 100-year floodplain area east of Jefferson and south of Farwell. Nineteen homes along Anchor Road, west of Jefferson, are also in a floodplain area. (third priority) On the west side of Jefferson to the west and south of Anchor Road are numerous structures presently at risk of flooding, and a new pump house across from Macon Street will be needed to alleviate this problem. Re-design and engineering to increase pump capacity and flow discharge will greatly lessen or remove the flood risks for 8 homes south of Anchor Road, in the 100-year floodplain, and 4 inland homes along the Schmidt Drain at Hendrie and Kingsberry Streets. There are also an estimated two homes and two apartment buildings that are within a lower-risk floodplain area, west of Jefferson Avenue. To the north of Farwell Street are about 45 houses that are in a lower-risk floodplain area. (last in priority)

In summary, there are three NFIP repetitive loss structures in this community. (top priority) There are about 224 structures in floodplain areas that are known or assumed to have suffered damages or to be at greater than base-flood risk levels (second priority). There are also about 271 structures that are at risk due to their location in 100-year floodplain areas, but have not yet had damage reported (third priority). At lesser risk but still worthy of mitigation efforts

to avert future damages are about 323 structures in lower-risk floodplain areas, and in addition there are about 36 homes protected from flooding by dikes or berms which may be susceptible to weakness or failure at some point in the future (last in priority). This section also described other at-risk properties which have had or will soon have their flood hazards mitigated, and a number of roadways which continue to be flooded over on a regular basis.

Clinton Township

This jurisdiction also has numerous problems needing mitigation. Descriptions of these problems are organized into paragraphs below according to the section of the township in which they are located. In general, one of the largest problems is that the Clinton River, with an 860 square mile watershed that is rapidly being urbanized, flows through this community and requires expensive cleaning and maintenance to prevent floods from occurring in the township. This would include removing debris from the main channel and middle branch, stabilizing riverbanks, and removing trees that are about to fall into the channel.

Section 2 – One house seems to be in a lesser-risk (probably 500-year) floodplain just west of Elizabeth Road in the far north of the section. Although it sits relatively high, it appears to be located very close to the floodway. (last in priority)

Section 3 – Two houses next to the Miller Drain just east of Heydenreich may be at risk since they appear to be in the 100-year floodplain area. (third priority)

Section 4 – One house on the east side of Romeo Plank Road just north of 19 Mile Road appears to be in a 100-year floodplain. (third priority) A total of five houses on the western edge of the section seem to be in a lesser-risk floodplain. (last in priority)

Section 5 – A total of 10 houses appear to be in lesser-risk floodplain areas around the Middle Branch of the Clinton River, the Groth Drain, and Sloede Ditch. (last in priority)

Section 8 – Three houses appear to be in a lesser-risk (500-year?) floodplain—two near Romeo Plank and Greenfield Roads, and one on Canal Road. The three Chippewa Valley High School buildings also appear to be located in such an area. (last in priority)

Section 9 – Along Heydenreich Road north of Cass Avenue, there are problems where the road crosses the Clinton River Middle Branch and the Miller Drain. The bridge over the Middle Branch floods over, and the roadway floods at the Miller Drain crossing. In addition, two nearby houses (one to the north and one to the south of the Miller Drain) are located in the drain's 100-year floodplain area. Two more structures are in the floodplain of the Clinton River on the south side of Cass Avenue. (third in priority) Eight apartment buildings near Cass, east of Romeo Plank, appear to be located in a lesser-risk floodplain area. Another of these buildings seems to be located in a 100-year floodplain, but no known flooding of any of these was known to local officials. In a subdivision southeast of that area, some street flooding occurs on Ingram Drive, but no houses have been known to be affected. Farther to the east along Cass Avenue, about 24 houses and 2 larger buildings are in lesser-risk floodplains (last in priority)

Section 10 – North of Cass Avenue and West of Little Road is a floodway/floodplain area placing 5 houses and a greenhouse at risk. (third in priority)

Section 12 – There are three houses on the north side of South River Road, just east of the Mount Clemens city limits, that are in a lesser-risk floodplain area. (last in priority)

Section 15 – South of Cass Avenue, along Bellevue Street, are eight homes which appear to be in the 100-year floodplain. According to local officials, however, these houses sit on higher ground than the surrounding landscape and so are at lesser risk (last in priority). The exception is one house that was identified as a repetitive-loss structure by the NFIP (highest priority). South and southwest of this, along the north of Moravian Drive, are two homes by the Clinton River that are in a floodplain. On Bellevue, southeast of Moravian, are two houses in a floodplain, along with the snack bar and maintenance shack for the Hillcrest Country Club. One of these floodplain structures is scheduled to be acquired and removed, once approval is received for the Macomb Hazard Mitigation Plan and authorizes funding for the project. (Three other homes marked on USGS quads in this floodplain area were no longer known to be in the area.) (third priority) Eight homes along Moravian Drive, Balfour, and Gary Streets that had been located in the 100-year floodplain were assessed by local officials as being lower risk. In the same area (and on Harrington Road) are 19 homes that are in lesser-risk floodplain areas. (last in priority)

Section 16 – The top ongoing concern in this area once these structures have been removed is that Clinton River Road regularly floods over in the area south of Canal Road. This road is locally important for residential use in an area that is quite well-populated, and during these flood events, it no longer becomes safe to use. (second priority) On the south shore of the Clinton River in this section are two houses that appear to still be in a 100-year floodplain area, on Riverhill Drive and Cypress Street. (third priority) On the north side of Clinton River Road, there is a house in the 100-year floodplain which local officials have assessed as lower-risk, and there is another house identified in a lesser-risk floodplain. South of the Clinton River, on Shana Drive and Byriver Street, are 11 homes in a lesser-risk floodplain. There are two more such houses on Riverhill Drive. (last in priority) Although the USGS quad for this area shows 11 houses in a floodplain on Kerner Street (including an NFIP repetitive loss structure), these houses have been removed from this hazard area and the land is targeted for acquisition to turn the area into a park.

Section 17 – There are two houses on the south side of Clinton River Road, just west of Romeo Plank, that appear to be in the 100-year floodplain. (third priority)

Section 19 – Three houses on the north side of River Lane are in 100-year floodplains, and their risks have been confirmed by the observations of local officials. Three houses just north of there, on the east side of Hayes Road, are also in floodplains, although no flood damages have been reported to officials. The same status applies to a house on Millar Road just south of the Clinton River. (third priority) The fire station at the corner of Garfield and Clinton River Road appears to be in a floodplain, as is the DPW garage to its south, and a house south of that (on Millar Road). Although these are all in 100-year floodplain locations, they were assessed by local officials as being at lower-risk.

This was also the case with a house on the south side of River Lane at Hayes Road, and 18 other houses on the north side of Millar Road. There are also three houses near Clinton River Road, and three on Millar Road, that are in lesser-risk floodplain areas. Surfaces in the south end of a trailer park in this area have been reworked (cut and filled) to better handle drainage waters, since the area was originally identified as a floodplain. Water is still seen over some local streets, however, and Millar Road gets flooded over where it crosses the Crooked Brook Drain in the southwest of this section. (last in priority) Sewage disposal facilities that were in a floodplain area next to the DPW garage no longer exist. An at-risk structure at the end of River Street also no longer exists there.

Section 20 – There is flooding over Clinton River Road in this area where it crosses over the Marsh Drain. (third priority) Along Clinton River Road are 14 houses in a lesser-risk flood area, and one that is in the 100-year floodplain but assessed as lower risk by local officials. There are also two apartment buildings in the lesser-risk floodplain, and there are two more that appear to be in the 100-year floodplain but which apparently were engineered to avoid flood damages and so are classed as lower-risk. Along the south side of the Clinton River (at scattered locations on numerous different streets) are six houses in 100-year floodplain areas but assessed as lower-risk by local officials, and about 28 houses in lesser-risk floodplains. (last in priority)

Section 21 – 15 structures are in lesser risk floodplain areas at the ends of Delta and Byriver Streets. In addition, another three structures appear on the USGS maps on Joanne Drive, and one more appears where Miles Street curves around near the Harrington Drain. Where Millar Road curves around into Nunneley Road, there are about 5 more houses in a lesser-risk floodplain, and 9 houses that appear to be in the 100 year floodplain but which officials have assessed as being at lower risk. (last in priority)

Section 24 – There is an erosion problem here, for which a bank stabilization project has been proposed, affecting about 2,000 feet of the drainage channel.

Section 28 – Next to the Harrington Drain are three structures that are in lesser-risk floodplains, at the end of Doty Lane and Nunneley Road. (last in priority)

Section 29 – Only two houses were identified as being in lesser-risk floodplain areas in most of this section, with some possible risks in the southwest of the area probably having been mitigated by the engineering around subdivision developments in a former floodplain area. (last in priority)

Section 30 – Around the Crooked Brook Drain in the northwest of this section are 7 houses in the 100-year floodplain (third priority) and two others nearby that are in a lesser-risk floodplain area. (last in priority) There is a pump station in this area that needs to be re-designed and engineered to increase its capacity and avoid back-ups.

Sections 35-36 – The Cottrell Drain causes some backyard flooding in this area, due to blockages that need to be cleared from its channel. (last in priority)

In summary, Clinton Township has had its one identified NFIP repetitive loss structure, and several surrounding it, readied for removal. (highest priority) It has some urban flooding problems along the M-97 Groesbeck Highway (especially between Kerry and Carlier Streets, which carries an average of about 30,000 vehicles per day) and frequent flooding over the road at Kelly Road and 15 and 16 Mile Road, which are also major streets in the area (these conditions were not described in the sections above.) Clinton River Road also floods over in section 16 of the township. (second priority) There are about 32 houses and 3 other structures throughout the township that are in 100-year floodplain areas, and 2 spots where flooding over important local roadways is a significant problem. (third priority) There are about 208 houses and 20 other structures that are in lesser-risk floodplain areas or which have otherwise been considered at less than 100-year risks, along with at least 1 area of minor street flooding. (last in priority)

Eastpointe

The city of Eastpointe has no identified floodplain areas within it, and no open drainage ditches either—its flooding problems stem from its location in the midst of the most heavily urbanized areas of Macomb County. Thus, the city's flood problems are of the "urban flooding" variety. About 85% of the city is served by combined storm and sanitary sewer systems. Only the northeastern 15% has these systems separated from each other. As a result, sewer backups may result in basement flooding and accompanying health concerns due to the nature of that type of floodwater. Many homes in the city were built with backflow preventers, but some homeowners have removed them over the years, due to ignorance about their function in preventing sewer backups into the basement. The city uses restrictive catch basin covers, so that most of the excess water can be kept from overwhelming the sewer system and possibly going into basements.

The city's current focus is to videotape and clean appropriate sections of its sewer system, to keep it functioning as well as possible. Structural damage found in the system is also repaired in a timely fashion. The result is that there are no areas of the city specifically known to have higher risks of flooding than others, but in some exceptionally heavy rain events, basement flooding does occur. Up to a foot of water may collect in some basements. Sometimes there are very few houses with any basement flooding, but other times, quite a few houses may have problems. The city has 13,684 housing units, according to the 1990 census. In the last two years, there have been about three events where ten or more houses reported flooding. The largest event was in July of 2000, in which two to three hundred houses reported problems. In September of the same year (the time of the disaster event in neighboring Wayne County), there were also problems, but many of the affected houses had already been damaged by the July event. Since the areas with combined sewer systems are more prone to flooding, a solution could be to separate the sewer systems in the rest of the city, but it has been estimated that such a project would cost more than a hundred million dollars and take more than 10 years to accomplish.

Fraser

In the city's southeast section is an area that floods regularly but is not identified on NFIP floodplain maps. It is a residential area known as Venetian Village, and includes such streets as Rainbow, Winsom, and Slumber Lane, but the area of worst flooding occurs around Breezeway and Eveningside Streets. About 200 homes in this neighborhood are considered at-risk for basement flooding. During each severe rain event, about 15 to 20 houses report basement flooding, but they are not always the same houses—risk is evident throughout this neighborhood but isn't pinpointed so precisely. Flooding in these homes is usually about an inch or two of water, and so damages usually vary depending on the presence of carpets or other items at floor levels in the basements of these homes, or nearby items subject to ill effects from excessive dampness. Masonic Road, to this area's north, and 13 Mile Road, to its south, also get flooded over regularly. The city has an extensive plan for cleaning out its drains to prevent flooding, but in this southeastern area, the nearest such drain is the Sweeney, a mile or more away to the west. (second priority)

In the north of the city, between the Harrington and Faulman Drains, are two small neighborhoods that are within a 100-year floodplain, comprising 23 homes in and around Garfield Circle, 4 buildings to its north, 23 structures in Woodside Manor further north across Mulvey Avenue, 9 more homes along Garfield Road, 4 homes along 15 Mile Road, and an industrial building and 6 more homes adjacent to the Harrington Drain itself. Twenty other homes nearby (mostly along Windham Lane) are in 100-year floodplain areas, and local officials agree that these homes are at-risk from flooding. (third priority) In that same area, there are 19 homes in lesser risk floodplain areas (between 100-year and 500-year limits). Also, part or all of seven industrial buildings on Klein avenue are in this kind of lesser-risk floodplain area. (last in priority)

In the western part of the city, there are various homes in 100-year floodplain areas: 2 on 14 Mile Road, 13 on Kingston Drive, 22 on Norwich and Oxford Courts, 15 on Cambridge Drive, and 40 more houses on streets like McNamee and Grove, down to the geographic limits of the NFIP study (near Hanover Street). (third priority) In this same area, 13 houses and 2 buildings on or near 14 Mile Road, 3 houses between Toulouse and Luxemburg Streets, 4 houses on Kingston Drive, and 22 houses from Hampton Court to Sherwood Lane, are located in lesser-risk floodplain areas.

In the central area of the city, there appear to be three houses and one building within the 100-year floodplain surrounding the Sweeney Drain. (third priority) Five houses are in lesser-risk floodplain areas along the Sweeney Drain just north of 14 Mile Road, and 15 houses and two buildings along this drain to the south of 14 Mile Road. (last in priority)

The city has a plan for cleaning out its drain systems to improve their capacities and reduce flood risks. There are projects suggested for areas of each of the city's major drains, cleaning out muck, trees, sediment, cleaning culverts and gratings, and even regrading sections of the Harrington Drain. However, as these types of projects may cost hundreds of thousands of dollars, it

is difficult for the city to fund them at the present time. One project, to remove trees and brush from the Harrington Drain and excavate a new section of the drain, is expected to remove about 40 homes from the floodplain if it can receive funding to complete it.

In summary, the city has a residential area (with up to 200 houses) that floods regularly, along with nearby streets. (second priority) There are about 186 structures located in 100-year floodplains (third priority) and 92 in lesser-risk floodplains (last in priority).

Harrison Township

This area has some of the most severe flooding problems in the entire county. There are nine NFIP-identified repetitive-loss structures. These houses are included in the counts of structures located in floodplains in the descriptions below. (highest priority)

In the strip of land west of the Selfridge A.N.G. Base, most structures are either located in lesser-risk floodplain areas (between 100-year and 500-year risk levels) or actually experience regular flooding. Of highest concern in this area is the area of manufactured homes (known as Willow Point) north of Joy Boulevard (along Lenfesty Drive). Although the area is mainly considered only a lesser-risk floodplain (Zone B), local officials report that the area is subject to repeated urban flooding (up to the L.C. Pankow Career Center) from runoff waters which flow through there and the undersized nature of the Irwin Drain. It is a very flat area, with waters from north and south flowing toward the Irwin Drain that passes through from west to east. Waters cannot flow away from the area quickly enough through this drain, whose capacity is exceeded, and 2½ to three feet of floodwater have resulted, causing damages throughout the mobile home park. The flooding here probably affects about 90 percent of the units in this mobile home park to some degree, and this park has about 300 sites in it. Damage varies from personal property to structural damage to the units, but unfortunately, dollar estimates of these damages are generally not available for these events, as most units are uninsured due to the lower incomes of these residents. Roads in the area are impassable and there is widespread surface flooding that affects all area residents. It is estimated that a higher capacity drain would reduce area damages by about 60%. The County Public Works Department is working on creating a mitigation strategy for this problem. Along with the need for a deeper drain, part of the problem is that the nearby I-94 crossing is too high. Some arrangement may be needed with the Michigan Department of Transportation on this issue, and costs may exceed two million dollars. It may also be possible to gain easements in court, and to use assessments on property owners to help fund the projects. There has been quite a bit of documentation on this area of flooding, including numerous photographs, a newspaper article (The Macomb Daily, December 19, 1997), and owner comments at a public hearing a couple years ago, for which a transcription should be available. Money has already been spent on an engineering study, and a project should soon be ready for this area. (second priority) About 38 commercial/ industrial buildings and two houses along Charles Street, Executive Drive, Irwin Drive and Production Drive are in lesser-risk floodplain areas, but Executive Drive is frequently flooded over and impedes access to this important industrial area. The County will try to have the Blankenburg Drain established as a county drain so as to allow them to address this problem (last in priority).

In the section of the township along the north side of the Clinton River, there are numerous areas at risk from flooding. The far eastern end of North River Road, near Belvidere Bay, frequently floods over, as does Island Street, making access very difficult for residents in that area. All of the houses and

structures located east of the Selfridge Air Force Base are within the 100-year floodplain area and therefore at risk from high lake levels, storm surges, shoreline flooding, riverine or canal flooding events. Although nearly all of these roads have canals running between them, the water level in Lake St. Clair is currently low and therefore temporarily alleviates most of these flood risks. From USGS quad information, there are estimated to be 351 houses and 10 commercial or public structures in this floodplain area. (second priority) Along North River Road (and Grandview Street) to the south and southwest of Selfridge, there are an additional 29 houses in the 100-year floodplain of the Clinton River. (third priority) In that same area (including Mapwood Street) there are about 67 houses that are in lesser-risk floodplains. (last in priority) A recently developed area at the end of Sea Ray Boulevard was engineered to resist damages, and it contains a number of minor roads that service a marina, with boat condominiums built on filled and raised ground for their protection.

In the far eastern portion of the township to the south of the Clinton River is another area of severe flood risks—extending from Metropolitan Beach, over the Black Creek, and to the Campau Bay on Lake St. Clair. This area also has almost all of its residential roads adjacent to canals or water bodies, and almost all of the houses are in 100-year floodplain areas, but fortunately infill development in this area has been constructed above base flood elevations. According to USGS Quads, there were 569 houses in the 100-year floodplains in this area. (second priority) South River Road regularly floods over at Lakeshore Drive and down toward the boat ramp at Sunshine Point. (third priority) Most of the structures (about 20 buildings) in the Metropolitan Beach Recreational Area itself are in lesser-risk floodplain areas. (last in priority)

Between the Clinton River and Metropolitan Parkway are some large neighborhoods. For ease of reference, the easternmost of these (northwest of Metro Beach, with Emerick Street running through it) will be referred to as the "eastern section," a middle area (the homes and neighborhoods on Columbia Street and Shoreline Drive over to those on Memory Lane) will be referred to as the "middle section," and a large western area (west of memory lane to the township edge) will be referred to as the "western section." In the western section is an area which USGS quads have marked with about 25 apartment buildings, which now has even more developments around it, that local officials consider top-priority for mitigation efforts in the township. This priority comes from the amount of benefit that could accrue from a relatively minor outlay of expenses (about \$150,000) to improve pumping capabilities at the North Point Parkway Station and retention pond south of these apartments. Runoff has increased from new apartments to the west and full development of the area to the north of them with expensive homes. Existing pumping capabilities are now considered substandard for the area's needs, and they should be increased to mitigate drain overflow flooding. (second priority) The eastern section has most of its houses located in 100-year floodplain areas. Using information from USGS quads, this means a total of about 253 homes and two buildings. Forty-one other homes that were classed as lesser-risk on the FIRM, located along and near the banks of the Clinton River (between Muffatt Street and Clearview) should instead

be considered higher-risk floodplain properties because of runoff problems in that area, street and stream flooding. The middle section has about 116 homes in the 100-year floodplain. The western section has 46 houses in the 100-year floodplain, located along the River and drains running through that area. (third priority) In the eastern section, there are about 40 homes and 4 buildings in lesser-risk floodplain areas, while the middle section has about 169 houses and the South River School building in lesser-risk floodplain areas. The western section has most of its structures located in lesser-risk floodplain areas, which are estimated from USGS quads as totaling 698 houses. (last in priority) Many new developments are reported to now exist in the middle section, but such are typically designed to avoid damages from flooding, and so are not included as at-risk even if their locations had previously been considered floodplains.

In the southwestern part of the township, south of Metropolitan Parkway, but west of Cherry Lane, are numerous built-up areas, which will be referred to as the "northeast section" (extending from Cherry Lane to just west of Siesta Street), the "central section" (extending from just west of Siesta Street to the Clinton River Spillway, and the "south section" (from the Clinton River Spillway south to the borders of the township). In the northeast section, most of the houses appear to be in 100-year floodplain areas, which according to USGS information amounts to about 292 houses. In addition to these, local officials identified about 30 others that they felt are at similar risk, due to their location near a drain that has difficulty bearing current runoff from inland areas. Also, by the waterfront in the northeast section, 160 houses that were classed as lesser-risk on the FIRM were assessed by local officials as having flood risks comparable to location in a 100-year floodplain. In the central section, there were about 76 houses and 1 shoreline building in 100-year floodplain areas. In addition, about 10 houses along Campau Lane were assessed by local officials as being similarly at-risk due to the condition of the Murdock-Ballard Relief Drain. This drain will be worked on, but this is expected only to reduce rather than eliminate flooding there. Pump station and detention basin improvements had been prepared at one time but for some reason the projects died. In the south section, there are about 65 houses and two apartment buildings in the 100-year floodplain near the shoreline. (third priority) In the northeast section, about 59 inland houses and St. Hubert's Church appear to be located in lesser-risk floodplain areas, the area all along the Vander de Buff Drain along Metropolitan Parkway suffers from flooding but doesn't impact any structures there, and new pumping station adjustments at Jefferson and Siesta Street are expected to alleviate problems from high lake levels causing inland flooding through those outlets. Monies have been collected to try to mitigate the drain's problems, and the Advance Measures program implemented some improvements to the drain at Jefferson Avenue. (Efforts were also directed at the Murdock-Ballard Drain and the Petit Conlet improvement projects.) In the central section, there are about 432 houses and 13 other buildings in lesser-risk floodplain areas, including the Jefferson School, a hospital, and a water works facility. New development has occurred in this area, but it is assumed in this report that such developments have been engineered to avoid flood damages. About eight houses on the

waterfront near the spillway that were identified as at-risk are no longer located in that area, according to local officials. In the south section, there are about 106 houses, 3 buildings, and portions of 2 other buildings, that appear to be located in lesser-risk floodplain areas. (last in priority) More generally, there is a pump station in this area that needs to be re-designed and engineered to increase its capacity and prevent back-ups.

In summary, there were nine repetitive-loss properties reported in the township by the NFIP (highest priority), a 300-unit trailer park affected by regular flooding, neighborhoods with about 920 houses and 10 other structures in 100-year floodplains that are susceptible to regular shoreline flooding from Lake St. Clair, and a residential area that would greatly benefit from a proposed mitigation project (second priority). There are 1118 additional houses, 5 buildings, and some roadways in 100-year floodplains (third priority). In lesser-risk floodplains, there are estimated to be 1581 houses, 81 buildings, and some roads (last in priority).

NOTE: Although the Selfridge Air National Guard Base is located in this township, flood information for that military facility was not readily available and was not taken into consideration for this plan.

Lenox and Richmond Townships

These two townships are considered together in this section of the report because the same local officials were contacted for both of them. Richmond Township is at a high elevation in the county and has its surface waters easily drain off into other, lower-elevation areas. According to local officials, Richmond Township has no areas of significant flooding. Lenox Township has some flood concerns, however, which will be listed according to geographic section of the township. The township's latest flood mitigation project has been to clean the Hill Drain between 30 and 31 Mile Roads to restore its drainage capacity. Funds (\$25,000) for this project were approved by the Intra-County Drainage Board from its Drain Emergency Operations Fund, part of the County Public Works Department, and the drain cleaning has been completed. For the last five years, the township has also been involved in floodplain management efforts.

Section 6 – Place Road experiences flooding in the north of the section up to 32 Mile Road. The depth of water over the road recently was about 2 feet, which caused a couple of cars to become stuck there. According to SEMCOG data, average traffic volume on this road in both directions is just under 300 vehicles per day, so this hazard will be classed as a local road that is temporarily impassable. (third priority) One house on 31 Mile Road at the East Branch of Coon Creek was considered to be in a lesser-risk floodplain. (last in priority)

Section 7 – The Hill Drain in this section has been cleaned, to help alleviate property flooding nearby. Widening of the drain may also be necessary.

Section 8 – One house on 30 Mile Road to the east of Deer Creek appeared to possibly be in a floodplain location, although local officials knew of no problems for that structure. The township has not had any thorough mapping of its flood risks, so it is not known whether this house should be classified as being within a 100-year floodplain or one of lesser risk. (last in priority)

Section 10 – Lowe Plank Road, between 30 Mile Road and 31 Mile Road, experiences severe flooding with water depths up to three and four feet. Every big rain puts this road under water. The worst area of flooding there is at the northern third of this stretch of road. Average daily traffic in both directions, according to SEMCOG data, is probably between 500 and 600 vehicles. (third priority)

Section 11-12 – 30 Mile Road gets flooded over with one to two feet of water, between the Grand Trunk Western Railroad tracks and Gratiot Avenue. According to SEMCOG data, about 400 vehicles per day, on average, would pass through this area, most of them traveling west away from the city of Richmond. (third priority)

Section 16 – Near some small lakes in the south of this section are about 7 homes between Smith Street and 29 Mile Road that appear to be susceptible to basement flooding. Local officials have received complaints of such damages, one of which was then confirmed. (second priority)

Section 17-18 – Two houses in section 17 near Smith Creek on 29 Mile Road appear to be in a lesser-risk floodplain area. Similarly, one house in

section 18 on 29 Mile Road near the Hill Drain appears to be in a lesser-risk floodplain area. (last in priority)

Section 20 – One house on 28 Mile Road near the Deer Creek appears to be in a floodplain. No specific information was obtained or available about its risk, and no damages were known to local officials, but this house is estimated to be in the creek's 100-year floodplain. (third priority)

Section 30 – Five houses in this section appear to be in floodplain areas. A more detailed assessment of their risks was not possible for the current study, so they will be considered to be in lesser-risk floodplain areas until more information becomes available. (last in priority)

Section 36 – 27 Mile Road at County Line Road is an area that experiences serious road flooding, with water depths estimated at two to three feet deep. This area is a locally important traffic route, with County Line Road handling an average of 7,000 to 8,000 vehicles per day (in both directions). Flooding in this area also blocks access for emergency vehicles. (second priority)

In summary, the township's top problems are the flooded roadways in its southeast section, and the seven homes that experience or are at risk of basement flooding in Section 16. (second priority) Three other areas of road flooding are of local concern, and a house appears to be in the floodplain in section 20. (third priority) A total of ten other houses throughout the township may be in floodplains as well, but these are probably lesser-risk floodplains. (last in priority)

Macomb Township

Macomb Township has a number of at-risk locations—most of which will be described below according to the geographic sections in which they are located. Some flood problems are more widespread, however. The top priority hazard in the township has to be the extensive, severe, and repeated flooding of North Avenue. Such flooding extends along this road for practically the entire length of the township, from roughly ¼ mile north of M-59 all the way to its northern boundary at 26 Mile Road. In the south of the township, this road averages 20,000 vehicles per day and is therefore a major local road. In the midst of the township its traffic counts are about 14,000 to 15,000 vehicles per day, and about 7,000 vehicles in the north of the township. (highest priority) Some of the crossroads also experience flooding in the vicinity of North Avenue, such as 24 Mile Road for about a third of a mile to its west (over 1000 vehicles per day on average), and 23 Mile Road (which is in a floodplain for a third of a mile to either side of North Avenue and averages more than 20,000 vehicles per day). (second priority)

Section 8 – In the floodplain of the Middle Branch of the Clinton River, according to USGS quads, are three houses in the 100-year floodplain. In addition, local officials have identified three more houses that are now at similar risk, due to current river conditions. (third priority) There are also two houses that appear to be located in lesser-risk floodplain areas. (last in priority)

Section 9 – There is only one house in the section that was identified within a floodplain. It is near 24 Mile Road and the Hammond Drain, in the 100-year risk area. (third priority)

Section 12 – There are two houses alongside Deer Creek that appear to be located in its 100-year floodplain area. (third priority)

Section 13 – There are seven houses near the intersection of North Avenue and 23 Mile Road that are in a 100-year floodplain area. (third priority)

Section 14 – There are two houses near the North Branch of the Clinton River that are in its 100-year floodplain. (third priority)

Section 17 – In the 100-year floodplain along the Middle Branch of the Clinton River in this section are six houses. (third priority) There is also one house in a lesser-risk floodplain. (last in priority)

Section 20 – There is one house in the 100-year floodplain of the Clinton River Middle Branch, on the east side of Romeo Plank Road. (third priority)

Section 21 – Just west of the Tilch Drain is a house in its 100-year floodplain. There is another near a drainage ditch to its east. (third priority) There are three houses in a lesser-risk floodplain area west of the Clinton River Middle Branch, at the intersection of Romeo Plank and 22 Mile Road. (last in priority) New subdivision developments in this (and other) areas of the township are assumed to have been engineered to avoid flood damages.

Section 22 – There is a portion of Card Road that regularly floods over where it crosses the McBride Drain. About 2,000 vehicles use this part of the road on an average weekday. (third priority) Two houses that used to be in a

floodplain on Card Road in this area have been replaced by a new school development.

Section 23 – Along the perimeter of this section, along Card Road, North Avenue, and 23 Mile Road, are a total of about 43 houses in 100-year floodplain areas. (third priority) There is also a house in a lesser-risk floodplain area on North Avenue. (last in priority)

Section 24 – Along North Avenue in this section are about 25 houses and two buildings (a hall and country club building). (third priority) There are also two houses in a lesser-risk floodplain area. (last in priority)

Section 25 – Near North Avenue are three houses identified in floodplain locations, and 19 others along Rochelle Street. There are apparently a couple of other streets now located south of Rochelle in the floodplain area, and while it is generally assumed that new housing developments (i.e. not shown on the USGS quads) are designed to avoid flood damages, it is not known whether the houses along Rochelle Street are relatively new (i.e. shown on USGS but built after the FIRM was drawn) and also designed to avoid flood damages. (third priority) There are four houses in lesser-risk floodplain areas. (last in priority)

Section 26 – There are an estimated 7 houses and 3 buildings in the 100-year floodplain area in this section (four others shown on the USGS map have since been removed). (third priority) There are an estimated 21 houses in lesser-risk floodplains in this section. (last in priority) New subdivisions have been built in this area but it is assumed their builders were cognizant of flood risks and designed their developments so as to avoid future damages.

Section 27 – There are only two houses identified in 100-year floodplains (third priority) and five in lesser-risk floodplains in this section. (last in priority)

Section 28 – The top priority in this section is road flooding over 21 Mile Road just east of the Middle Branch of the Clinton River, which is encroaching on expensive homes in the vicinity. 21 Mile Road in this area carries a daily average of about 20,000 vehicles and is an important local road. (second priority) There were only two houses identified in lesser-risk floodplains. (last in priority)

Section 29 – Only one structure in a lesser-risk floodplain in this section. (last in priority)

Section 30 – Only two structures were identified in 100-year floodplains in this section. (third priority)

Section 31 – About four homes along Canterbury are in lesser-risk floodplain areas. (last in priority)

Section 33 – Flooding over 21 Mile Road is encroaching on expensive homes in a nearby subdivision (as related in the description for section 28). (second priority) Three houses are in lesser-risk floodplain areas in this section. (last in priority) One commercial building that had been in a floodplain has had its risks mitigated by the construction of a nearby retention pond.

Section 34 – Only one house identified in a 100-year floodplain in this section. (third priority) Eight other houses appeared from USGS maps to be located in lesser-risk floodplain areas, but two or three of these have probably been replaced by new developments that have been designed to avoid flood damages. (last in priority)

Section 35 – It is proposed that four houses in a floodplain area on Patnik Street be elevated by 4 to 6 feet to avoid future flood hazards. (second priority) 24 other houses in this section appear to be located in 100-year floodplain areas. (third priority) 12 houses appear to be in lesser-risk floodplains. (last in priority) One structure that is on the USGS map but is now gone was an old farmhouse that used to be in the 100-year floodplain.

In summary, Macomb Township's most pressing flood problems involve road flooding conditions which greatly impede traffic and in some cases even affect nearby houses. (highest priority and second priority) Four houses in a floodplain have been proposed for elevation to reduce risks from flood hazards. (second priority) There are also about 153 houses and 5 buildings in 100-year floodplains throughout the township. (third priority) Finally, 66 houses appear to be located in lesser-risk floodplain areas. (last in priority)

Mount Clemens

Two-thirds of the city has separated sanitary and storm sewer systems, and one third has these systems combined, which is less safe and efficient at handling their contents. The Clinton River runs through this city (along with part of a spillway to more directly allow its waters to reach Lake St. Clair) and groundwater levels rise along with those of the river, causing infiltration into sanitary interceptors. Sanitary back-ups result in basement flooding in a row of an estimated 20 homes along Wellington Crescent Road west of Gratiot. In one of the areas of combined sewers, there is street flooding that occurs on parts of a major highway that goes through town—northbound Gratiot (M-3), which carries an average of at least 20,000 vehicles per day toward downtown Mt. Clemens. Most rainstorms that precipitate more than a quarter-inch of rain per hour will cause flooding along that street, particularly between Church and Robertson Streets, where waters can reach a depth of one foot and therefore seriously impede traffic flows. (second priority) Other street flooding of concern occurs on portions of Rose Street—one north of Cass Avenue, one at the intersection with Hubbard Avenue, and another one north of Church Street. Next in priority for urban street flooding, as identified by local officials, is Hubbard Avenue between Washington and North Avenues, followed by Cass Avenue between South Gratiot and Lodewyck (in front of the Mount Clemens High School and library), Riverside Drive around Woodside Circle, Elizabeth Road near North Avenue, and Clinton River Drive east of the Edison Charter school. It must be noted that flooding near the school impedes emergency access. (third priority) There are 8 houses that appear to be located in a 100-year floodplain area in the southwest side of the city, northeast of Mt. Clemens General Hospital, but which were assessed as lower-risk by local officials. Comparisons of USGS and FIRM data showed 16 other houses and 4 buildings throughout the city that were shown as located in lesser-risk floodplain areas. In addition, various other areas are located in floodplains, but due to their higher densities of development, the USGS does not provide information on the specific number of structures in these areas, merely shading them on the maps to show their urban nature. It is estimated that there are 38 houses (along with the Edison Charter School and two trailers associated with it) in the area east of Barbara Street and south of Robertson Street, 40 houses in the area east of Meadle Street and north of Robertson, 30 houses around Michigan, Gibbs, Judge, and Avery Streets, and probably 6 more around 1st Street and Riverside that are all in lesser-risk floodplain areas. This totals 142 structures throughout the city. (last in priority) Two large buildings that appear on USGS quads as being in a floodplain are actually part of a marina and so are not considered vulnerable.

New Baltimore

Practically all of this community's flood problems are in the shoreline area south of Main Street, especially since the Crapeau Creek on the north side of the city was dredged out 2 years ago, which alleviated flood risks to a couple of properties in that area. According to local officials, the highest priority among the city's flood problems should be given to a residential shoreline road (Base Street to the southeast of Front Street) which experiences regular flooding during high water levels but is only ten feet wide and therefore very difficult to gain access to during such events. According to USGS information, there are 10 houses in this area (classed as 100-year floodplain), and 7 others in more inland locations around this road. Two of these houses are NFIP-identified repetitive-loss structures, and sandbagging activities have been observed to try to protect other floodplain structures from damage. (highest priority)

There are about 18 other houses located in 100-year floodplain areas, south of that area. They are located on Taylor, Rose, Viola, Bal Clair, Schmid, and Lempke Streets. Due to their shoreline locations, it is assumed that most of these houses have actually experienced flood damages in the past. (second priority) In the vicinity of these homes are about 28 others that are classified as lesser risk on the published FIRM. Due to the difficulty of accurately matching the Flood Insurance Rate Map to the precise locations of these homes, and their proximity to canals and other shoreline flood hazards, it could be advisable to consider them as if they were all located in the 100-year floodplain during periods of high lake water levels, as in the events of 1985-1986, or during periods of storm surges or strong winds (as occurred in a 1997 event). Use of sandbags and dikes are typical during periods with high lake levels to protect these areas from damage. A final, unique problem in this community is that because of some drainage problems on Green Street (the main business and commercial street through town), various businesses that are located close to the road suffer from water that is splashed by vehicles against them. This condition must surely also discourage many pedestrians from walking in this important business area. Drainage improvements have been proposed as part of a state highway (M-29) project, but no action has actually been taken on this idea yet. The highway averages more than 30,000 vehicles per day. (third priority)

New Haven

This village has some structures that appear to be in floodplain areas identified on the community's FIRM. The most serious risk area is probably where Haven Ridge Road crosses the Shook Drain. Local officials report that this bridge has undergone repairs. There are about 8 houses here that seem to be classified in a 100-year floodplain area (Zone A6—third priority), and 6 more in the lesser risk floodplain area (between 100 and 500 year – last in priority). These houses either have Haven Ridge Road or Elk Street addresses. The area is known to have flooded in the past, although it has had no problems observed recently. The floodplain extends to the northeast of the area, and places some more houses at risk, along Clark Street, west of the railroad tracks. About two houses there are in the "A6" floodplain area (third priority) and 2 more are in a lesser-risk floodplain (last in priority).

Further north along the Shook Drain, where it crosses Clark Street (just east of Pine Street), there are about 3 houses in the "A2" 100-year floodplain (third priority). To the southeast, the Shook Drain passes by the dead-end of Morgan Street, where one house is in the "A2" floodplain area (third priority). The drain also crosses Gratiot Road (M-19), where one structure is in a lesser-risk floodplain area (last in priority). Local officials have not received reports of any flooding in these areas.

On Main Street, between Carl Street and Will Street, heavy rains cause waters to flow off the road and pool in the yards of nearby homes which sit at lower elevations. Only the front yards of about 20 houses in this area have been affected (last in priority).

In summary, there are about 14 houses in the 100-year floodplain in the village. (third priority) There are also 9 structures in the village that are in lesser-risk floodplain areas, with less than a one percent chance per year of flooding. There are also about 20 properties that experience yard flooding only. (last in priority)

Ray Township

A problem that was noted by this community is that while homes that are built under elevated conditions are protected from flooding, such construction increases risks for low-lying homes due to fill and increased runoff. Local officials note that the Coon Creek must be cleaned, or it will fill in the area of New Haven Road and the water, having no place to drain, will back up over everything to the north. On the flip side, increased runoff from the Healy Brook being cleaned for a mile and a proposed 400-unit mobile home park at 28 Mile Road (which is being contested in court) will adversely affect the downstream community of Davis (a small unincorporated town).

There are several serious problems with flooding in Ray Township. North Avenue floods over just north of 29 Mile Road (average daily traffic—8,000 vehicles) and threatens nine structures in that area. Three of these structures are local businesses east of Ray Center, while the others are houses. All should be considered to be in a 100-year floodplain area. Water flows into yards and parking lots, to the front of a house, and in the worst case, one house had 6 to 7 inches of water in it in February 2001. A house on North Avenue just north of 26 Mile Road was flooded in 2001 when the East Branch Coon Creek backflowed into the house, placing 18 inches of water into its basement. It is an older house with no backflow preventer. 26 Mile Road, which carries an average of about 12,000 vehicles per day, was recently closed for three to four days due to flooding. Aerial rescue was needed for occupants of cars that were stuck in the water, which came right up to nearby houses, perhaps even damaging some of them. There are three houses on the north side of the road there that should be considered located in at least a 100-year floodplain. (second priority)

At 30 Mile Road and Romeo Plank, the intersection floods over, and the road to its west had to be closed recently (average daily traffic only a bit more than 300 vehicles). There are three houses nearby that these floodwaters approach during such events, but no known damages have yet occurred there. 31 Mile Road experiences road flooding as well, between Hartway and Wolcott (a two-mile stretch), and the road was actually closed for a day due to this flooding. There are only a bit more than 200 vehicles per day on average that use this road, however there appears to be a house on it near the Priest Drain that is in a lower-risk floodplain area. An area of North Avenue with traffic averaging over 7,000 vehicles per day (near Coon Creek south of 31 Mile Road) also experiences road flooding. In section 25, there is a house just west of Coon Creek that should be considered to be in a 100-year floodplain. Floodwaters have been observed going up to this house, covering its driveway, and damages may be likely in the near future. Five houses on Indian Trail Road north of 26 Mile Road are also considered to be in 100-year floodplain locations. (third priority)

The Tupper Brook is flooding over in the far north (in section 2), resulting in a yard-flooding complaint from a nearby homeowner. Farther south, yard flooding from this Brook occurs all along the east side of Indian Trail Road. Local

officials state that this flooding is all from deposition into the drain, and that if the drains were cleaned, the problem would be alleviated. (last in priority)

Richmond, City of

The main problems experienced in this area involve runoff to low-lying areas in town, such as that south of Park Street and west of Main Street. The worst conditions involve snowmelt flowing over frozen ground, collecting in the yards of homes in this low-lying area. In some places, the water pools to depths of 2-½ feet. If connections could be made from these areas to street drains, the problem might be alleviated. The cost of this would be about \$200 per house, but needs coordination among area residents to implement. Ridge Road has about 8 homes that experience backyard flooding, which could be alleviated by the installation of a drain to carry waters away to the northeast, which is the direction of drainage through this area. Ridge Road is scheduled for reconstruction in 2002, and the affected yards are about 10 feet below street level.

The other flood concern in Richmond is an occasional report of sewer backups into home basements. These have occurred at dispersed locations and the problems are under investigation. The cause appears to be that surface waters get into the sanitary sewer system and, in combination with other factors such as a plugged main, may cause backups. Only about half a dozen reports of such backups have been received, but efforts are underway to pinpoint problem areas in the system and correct them.

Roseville

The highest priority project for this city is to make improvements on their aging lift stations, which are relied on to prevent basement flooding. It is important to have reliable power backups for these stations. Currently, there is only one generator, but two stations that would have need of it during periods of power failures. One station (on Washington between Little Mack and I-94) was built in the mid-1950s. The other station was upgraded in 1980 and is located on 13 Mile Road four blocks east of Hayes Road. Combined sanitary and storm sewer systems are located in the southern part of the city, and basement flooding is most common in the areas around Huron Park—usually amounting to a few inches of water on the floor in homes where there was backflow. There is restricted drainage capacity at and south of Frazho and Groveland that should be corrected. The idea of separating the sewer systems is currently lower priority and should be cleared with the downstream community of St. Clair Shores to ensure that it could handle water flows.

Gratiot Avenue (M-3) is prone to temporary flooding from heavy rains just north of 12 Mile Road for a length 4 to 5 blocks long. This road flooding generally gets about a foot deep and only lasts 1 to 1-½ hours, but since this is a major highway that carries an average of more than 43,000 vehicles per day, were such flooding to occur during peak travel hours, probably 7,000 vehicles would be slowed or diverted onto other roads. The basins along M-3 are currently being cleaned to help retain water away from the road. (second priority)

Shelby Township

Although official FIRM and USGS information had indicated numerous structures in floodplain areas of varying risk, local officials have observed very few incidents of flooding in the township. The area has sandy soils that drain water efficiently. Many new developments have included extensive use of retention ponds and detention basins to mitigate flooding. Although floodplains around the Middle Branch of the Clinton River have been identified as significantly overlapping developments in sections 9 and 16 of the township, local officials report that it is really only a creek with six inches of water that flows through this area. For the present, the FIRM is considered inaccurate (initially, 84 houses had been identified by this data source as being in 100-year floodplains, and 29 houses and 1 building in lesser-risk floodplains). By contrast, the only known area of flooding in the township is around the Recreation Area on either side of Ryan Road. Six structures are estimated to be in a 100-year floodplain in this area, the most significant of which is probably the Loft Bar near Ryan Road. Other structures in the area are generally little-used or less-important park-related buildings. (third priority)

St. Clair Shores

The city still has risks from shoreline flooding, when lake levels are high, although things have greatly improved since the Flood Insurance Rate Map was made in 1979. Many problems had stemmed from the use of direct outlets to Lake St. Clair, which would provide an avenue for lake waters to flow inland under particular conditions. Only about a dozen direct-drainage outlets to the lake are still in use. Others discharge to the Jefferson area first, with pump stations to prevent back-ups, alleviating the major problems that used to exist. Flooding south of O'Conner Street is no longer a major problem, and the floodplain area north of that street will soon have a new pump installed by the U.S. Army Corps of Engineers. The flood problems in the city are now mainly to the east of Jefferson Avenue. About eight houses (out of 13 that were proposed in a 1999 Hazard Mitigation Grant application) have agreed to elevation projects, raising them up to 4-½ feet so as to mitigate flood damages. A major project the city wishes to undertake involves the construction of a relief sewer from the northern city limits to the Hoffman Lift Station. The system currently cannot adequately transport rain-induced peak flows, with problems of untreated stormwater discharges to Lake St. Clair resulting.

Five structures have been identified by the NFIP as having suffered repeated flood losses. Their locations are all near the shoreline of Lake St. Clair, on the eastern edge of the city. (highest priority)

Between 9 Mile and 10 Mile Roads, a shoreline flood area includes marina buildings (which shouldn't suffer any major damages), a Coast Guard facility, and possibly a few restaurants. A project has been proposed to reduce wave and flooding effects on the coast guard facility by replacing current culverts under its single-lane access road with either larger and more numerous culverts, or a bridge-like structure. 10 Mile Road east of Jefferson receives regular street flooding, and a residential area extending four to five blocks north of 10 Mile Road (Statler Street) is still considered at risk from flooding. Houses in this area tend to have crawlspaces rather than basements, and flooding generally does not quite get above the first floor, but wave action worsens risks for these houses. Statler Street was shown in the FIRM as lesser-risk floodplain, but should instead be considered to be in a 100-year floodplain location, due to its problems of flood susceptibility. There are an estimated 150 houses in this area that are at-risk from flooding. Other areas of residential floodplain areas are the five or so streets south of Ardmore around Koerber Street (with about 150 houses), and the shoreline area east of Jefferson from 11 Mile Road up to about 13 Mile Road (with about 150 houses and 2 apartment buildings). Jefferson Avenue north of St. Gertrude experiences problematic street flooding, and it carries an average of about 18,000 vehicles per day. (third priority) One of the mitigation projects proposed is to remove a house that is in the floodplain (sitting at a location that is 50 inches below base flood elevation) and which is located within a county drain easement.

The area around City Hall and the streets immediately to its south had previously been identified as a floodplain area, but are no longer considered a

big problem area, meriting a Letter of Map Amendment (LOMA) to the FIRM. Structures north of 13 Mile Road currently have no more known problems, due to changes made in the drainage system.

Sterling Heights

This city has been extremely proactive in its flood mitigation efforts. Most of the risks identified on old FIRM and USGS data has now been eliminated, through home elevations, creation of retention ponds, and planned redevelopment of hazard-prone areas. Although a number of homes were identified from the old data as possibly at risk, there are currently no reports of homes in the city experiencing such flood risks. For example, apartment buildings located in a 100-year floodplain in one area near Van Dyke Road have their lowest level used for parking. The city actively participates in both the National Flood Insurance Program (NFIP) and the Community Rating System (CRS). A CRS information sheet reports no repetitive loss properties in the city, and that the city has qualified for discounts in its residents' insurance rates as a result of its activities. The city still has identified projects to keep drainage conditions acceptable for all parts of the community. For example, a section of the Plumbrook Drain has been identified as needing a capacity improvement and riprap protection on its banks, while other segments of the drain needs sediment and underbrush removed, so as to restore full water-carrying capacities.

Utica

A repetitive-loss structure is located in this city. (top priority) The Clinton River flows through this city, but the river has debris problems and needs dredging, so there are flooding problems on the south side of town. A detention area is needed on the north side of M-59, where an 84" state drain currently passes by. The city library and another building are in the river's 100-year floodplain just north of M-59. The other at-risk structures are all on the south side of M-59 and practically all on the west side of the Clinton River. There are about 54 houses, 7 duplexes, and 4 buildings in this floodplain area. One of these is a relatively new building with 54 units for senior housing, which is 3 stories and has parking underneath it to help elevate the living areas above floodplain levels. However, an elevator shaft and related equipment is still affected by floodwaters. The equipment must be elevated, or the water at least pumped away from it. Other buildings include a collision shop, gas station, and car wash on Van Dyke Avenue, but these are elevated above likely flood levels. The worst area of flooding is around Davis Street south of Nichols Street, around where the duplexes are located. In some spots, the water depths are four to five feet over ground level, and homes are accessible only by boat. In 2000, the area flooded four times. Another flood event occurred in February 2001. It is proposed that the most affected homes be elevated so their living areas are above the base flood elevation. Davis Street itself suffers excessive heaving and cracking from the effect of these waters, and this could be addressed by replacing the base course and road surface of the road, with perforated edge drains added on each side of it. (second priority) An automated pump to prevent street flooding used to be in this area. Currently, gas pumps are used, which are more cost-effective but need to be manned to operate. About five other houses in the city are in lesser-risk floodplain areas. (last in priority)

Warren

Initial data from the FIRM and USGS indicate that it is the northern-central part of the city that has the most problems from flooding. These problems will be identified and discussed according to the sections in which they are located. Although these sections have extensive listings, local officials report that *most buildings have been constructed slightly above ground level*, and that **no specific flood damages have recently been reported in the city** from riverine flooding.

A broader goal throughout the city is one of public awareness—how residents can get water to drain away from the foundations of their houses to prevent basement flooding. Footing drains in many houses are tied into the city's sanitary sewers. A couple years ago, more than a hundred houses reported basement flooding. In a typical rainstorm, about 8 or 10 report basement flooding. There are a total of about 54,000 occupied housing units in the city, and those with problems are scattered throughout the city rather than in any specific area. The one exception to this is an area with the lowest elevation that has recurrent basement flooding, on Autumn Lane and Jane Court. About 10 to 12 houses in this area have had recurrent basement flooding, with depths of 6 to 12 inches. Sump pumps have been employed in some of these homes to try to reduce the amount of damage from these floodwaters. (second priority) There is also some residential street flooding in this same area on Blossom Court, west of De La Salle School, around Common Road. Depth of the waters is as much as 12 to 18 inches, rendering these streets temporarily impassable, before it begins to drain off after 1 to 1-½ hours. (third priority) The city's storm and sanitary sewer systems are separate. Six to seven years ago, a pumping station at 9 Mile Road and Schoenherr was upgraded, along with a sewer main, to reduce basement flooding problems. Basement sump pumps also helped to solve the problem in many homes.

Section 2 – Just south of 14 Mile Road and the Red Run River, there is a residential area with six houses and 5 apartment buildings in a 100-year floodplain. A pumping station just north of there was built in 1980 but now acts as a dam, and a petition to remove it has been filed. Raising the grade of the road may also help mitigate flood problems in this area. (third priority) Just south of 14 Mile Road and the Red Run River are about 23 homes and 6 apartment buildings in a lesser-risk floodplain. At similar risk but a bit more distant is a church building, two other homes on Hoover Road and some small portions of a few residential neighborhoods to its west. (last in priority)

Section 3 – To the southwest of this area is an apartment community on the streets around Bear Creek Drive that contains about 26 buildings and one house in the 100-year floodplain. A berm is being constructed along the Bear Creek and Red Run River to try to alleviate flood risks in that area. South and west of this Bear Creek Drive area are at least two houses and possibly some industrial buildings in the floodplain. In the north of the section, along the Big Beaver Creek, 12 houses and three buildings are in the floodplain, including a wastewater treatment plant. Floodwaters have so far only been observed going

up to the park across from this plant. (third priority) In the Bear Creek Drive area, there are about 22 buildings and 4 houses in lesser-risk floodplain areas, with at least 3 more houses and possibly one industrial structure in areas to the south. In the north and along the Beaver Creek are about 31 houses and 4 buildings (last in priority)

Section 4 – In the northeast, the Big Beaver Creek has a floodplain that places some structures at risk. Two restaurants, a couple of golf club buildings, two other buildings, and a couple houses are all in the 100-year floodplain there. There is another floodplain area along the Red Run Creek, which seems to have 2 commercial and 2 light industrial buildings (a factory and a warehouse), a bank, a Knights of Columbus Hall, 3 other buildings, and about 25 houses in it. There are also a few General Motors buildings in this area, but re-cutting of area topography has doubtlessly allayed risks to those buildings. (third priority) In lesser-risk floodplain areas are 3 buildings by the Big Beaver Creek, and 4 buildings, about 8 houses, and a large General Motors building. Lesser-risk floodplains in Warren refer to those somewhere between 100-year and 500-year assessments on the FIRM. (last in priority)

Section 5 – Area's like this one that are located west of Mound Round have had flooding problems greatly reduced by an upgraded bridge (on Mound Round at the Red Run Creek). This alteration has resulted in a letter of map amendment (LOMA) for the area's FIRM, removing about 90 houses and some other buildings from the 100-year floodplain. Nearby, there is a low-lying spot that will have a berm constructed to help protect the several houses in that area.

Section 6 – As in section 5, there were a few houses that were originally identified within the floodplain of the Red Run Creek that are now at lower-risk as a result of the bridge upgrade at Mound Road which has improved drainage in the area.

Section 9 – There are many large buildings in this area that seem to be in lesser-risk floodplain areas. These are seven very large industrial buildings, and about 14 other buildings that appear to be at-risk according to the FIRM. (last in priority)

Section 10 – There is a small business in a 100-year floodplain area, by the Bear Creek at Van Dyke and 13 Mile Road. (third priority) An office zone that had appeared to be in a floodplain was addressed by a LOMA and no longer considered at significant risk. (last in priority) Four buildings and part of a residential neighborhood that had appeared to be within a lesser-risk floodplain area near that addressed by the LOMA area probably do not need to be worried about since their risk is probably now even lower than is normally identified.

In summary, there is a low-lying area with street and basement flooding (second priority), a total of about 45 houses and 24 buildings in 100-year floodplains, (third priority) and at least 69 homes and 59 buildings in lesser-risk floodplain areas. (last in priority)

Washington Township

Areas at risk from flooding are identified below according to the geographic section of the township in which they are located. Seven other structures (not listed below) that had been tentatively identified as within floodplains have been evaluated by local officials as either not at risk (primarily due to elevated location) or as no longer existing. The township has a high elevation and local officials know of no serious structural flooding.

Section 7 – The Clifton Mill is a historic structure (although not officially registered as such with the State of Michigan) that is in the 100-year floodplain area of Stony Creek. The culvert near it is two-thirds full and should be replaced. (third priority)

Section 9 to 10 – 30 Mile Road experiences street flooding for about a half-mile stretch, impeding access to the entrance to an orchard here. That area of section 9 was outside the limits of the FIRM study, and it is possible that up to three structures may be in a floodplain there. In section 10, the road flooding was serious enough to close 30 Mile Road for 8 hours (in a February, 2001 incident) with as much as 18 inches of water depth in this area. About 1,500 vehicles use this road per day, on average. (third priority) Two houses along the road in the floodplain are elevated above risk levels.

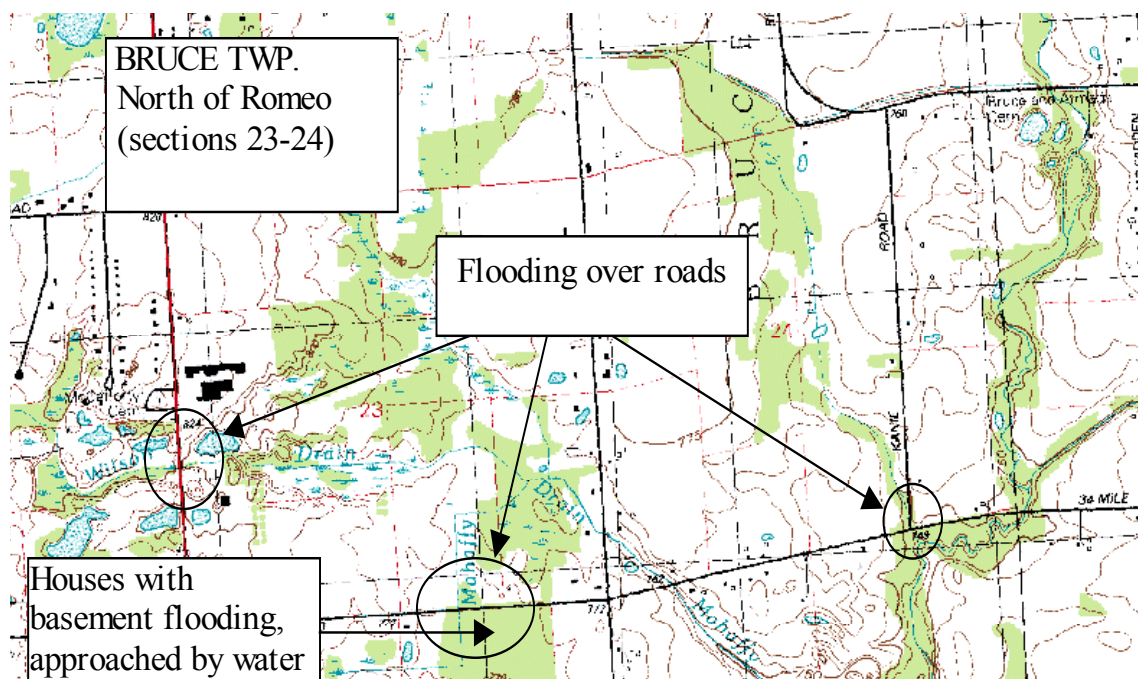
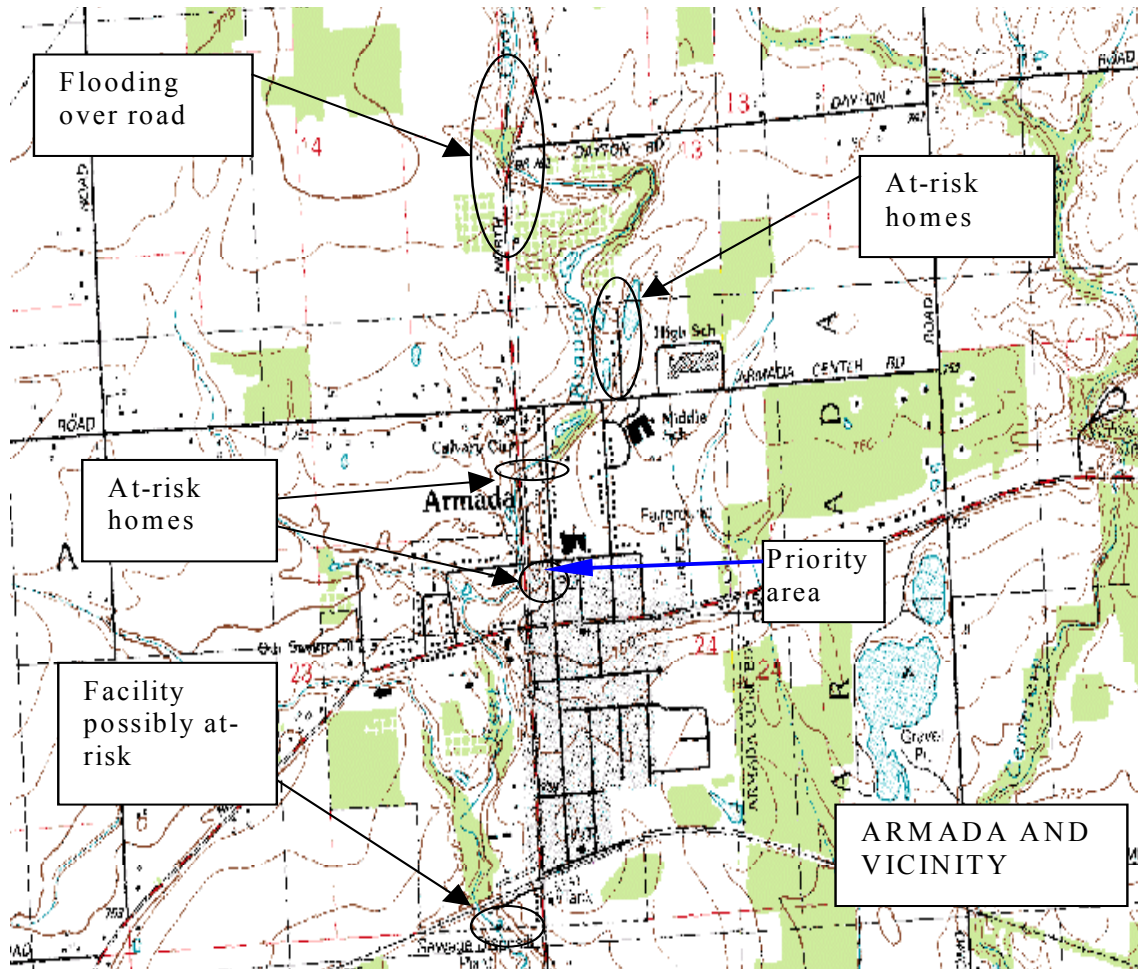
Section 15 – The drain running through the neighborhood in the northeast of this section floods over regularly for about a hundred feet on either of its banks, with floodwaters reaching up to eighteen inches in depth. It is not clear how threatened these houses are from actual surface flooding, but at least one of the local roads becomes temporarily impassable in this area. To the south, toward 29 Mile Road, water drains down hills (with sheet flows of four to five inches in some spots!) and builds up in the yards of condominium units. Two houses have recently experienced basement flooding, with at least a foot of water needing to be pumped out of them. (second priority) Water builds up and then goes down and over 29 Mile Road in sheet flows. 29 Mile Road at this point carries a daily average of about 2,500 vehicles, but has not actually been closed off during such flooding. (third priority)

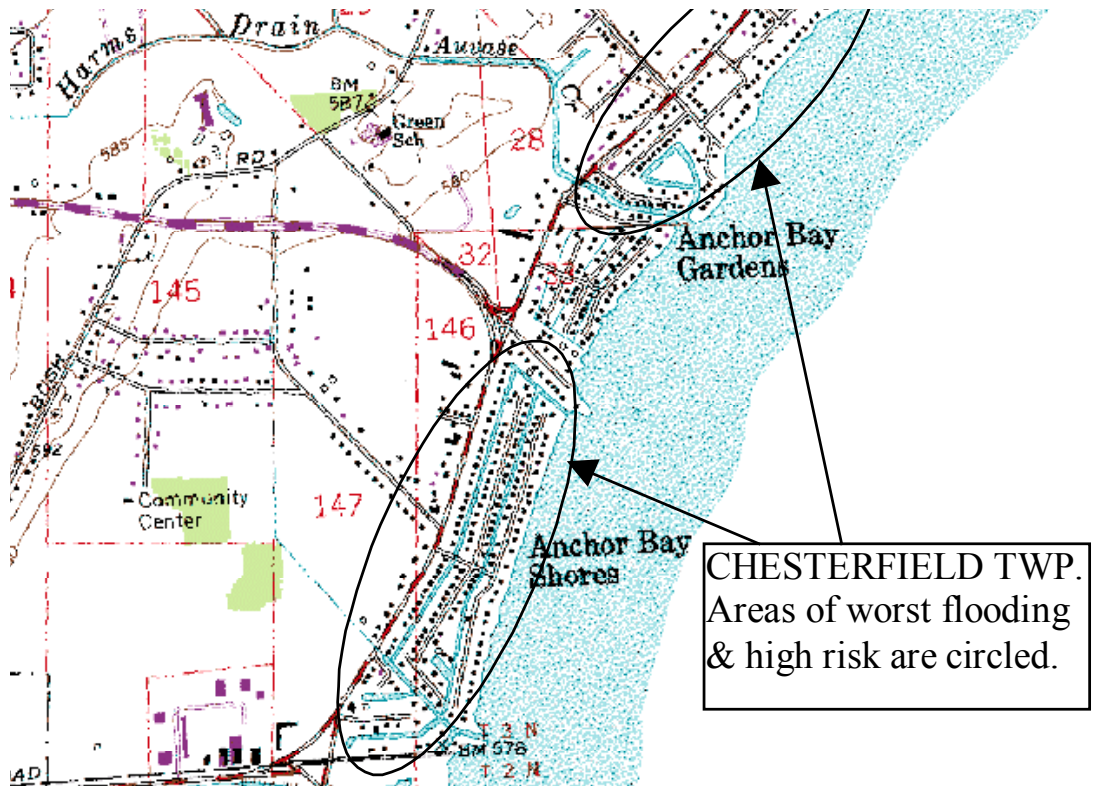
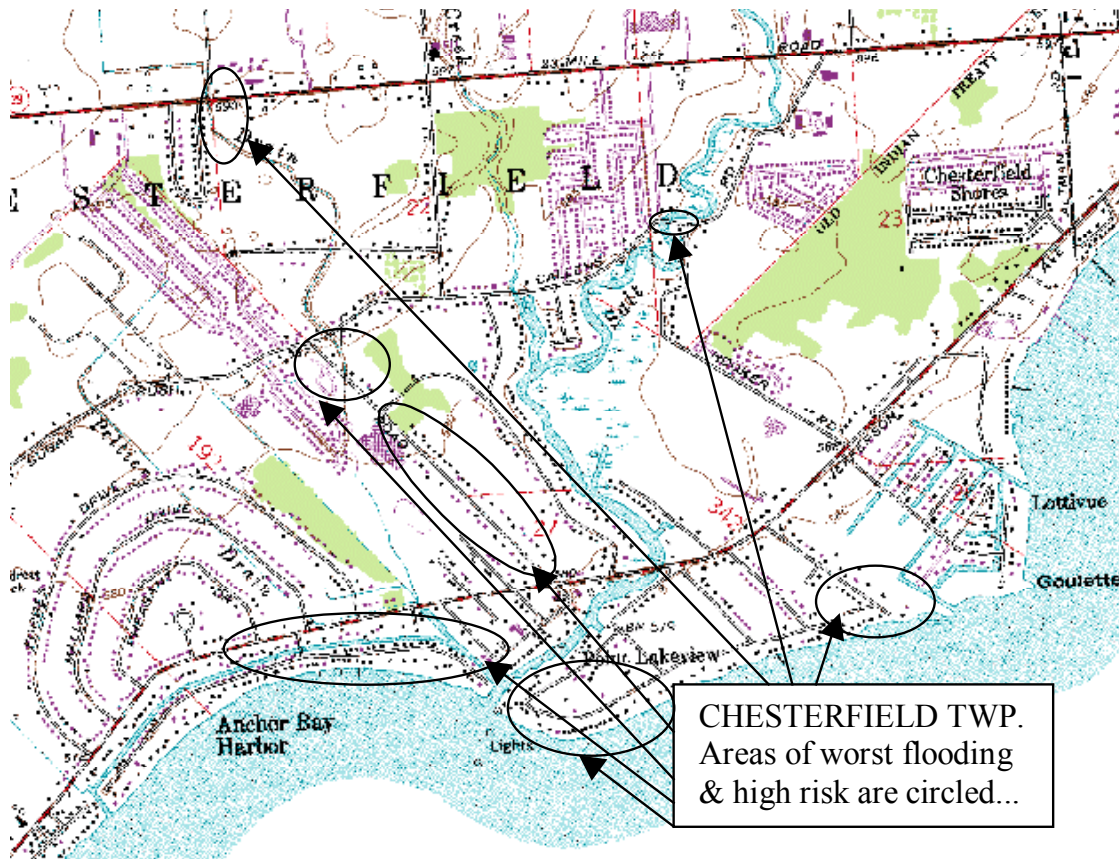
Section 26-27 – A drain flowing through these sections has a 100-year floodplain that includes two houses on or near Jewell Road. (third priority) In the lesser-risk floodplain of this drain exist three houses. (last in priority) A separate drain/floodplain in the very south of section 27 has a LOMA removing its two houses from floodplain designations, due to a channelization that has been completed there.

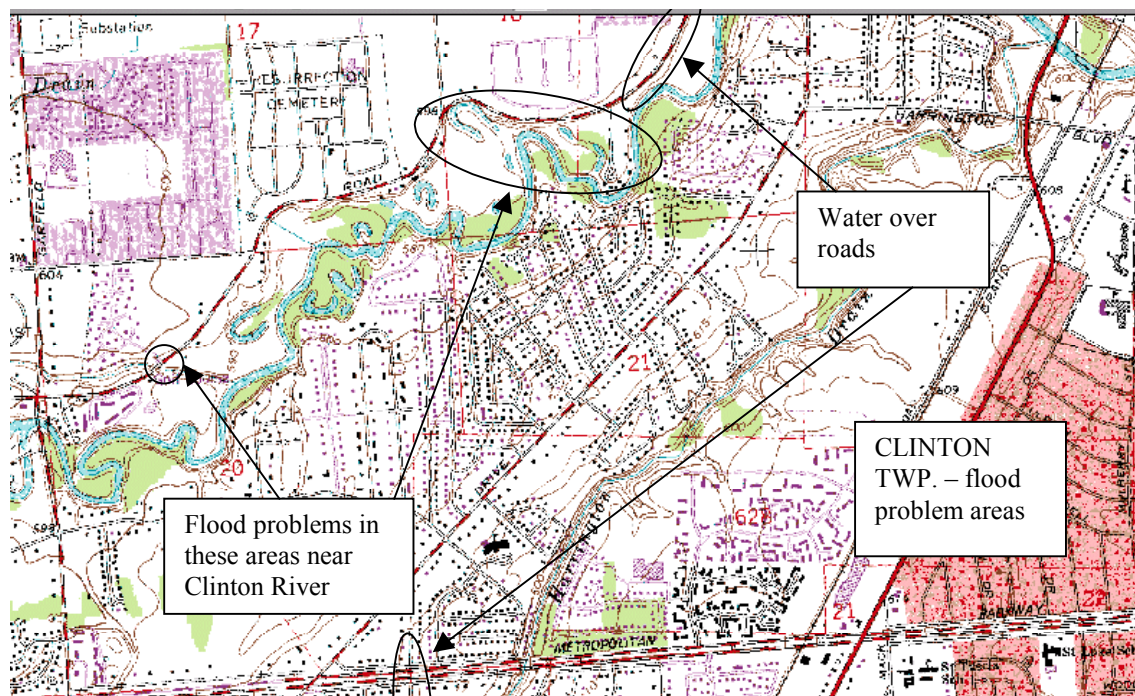
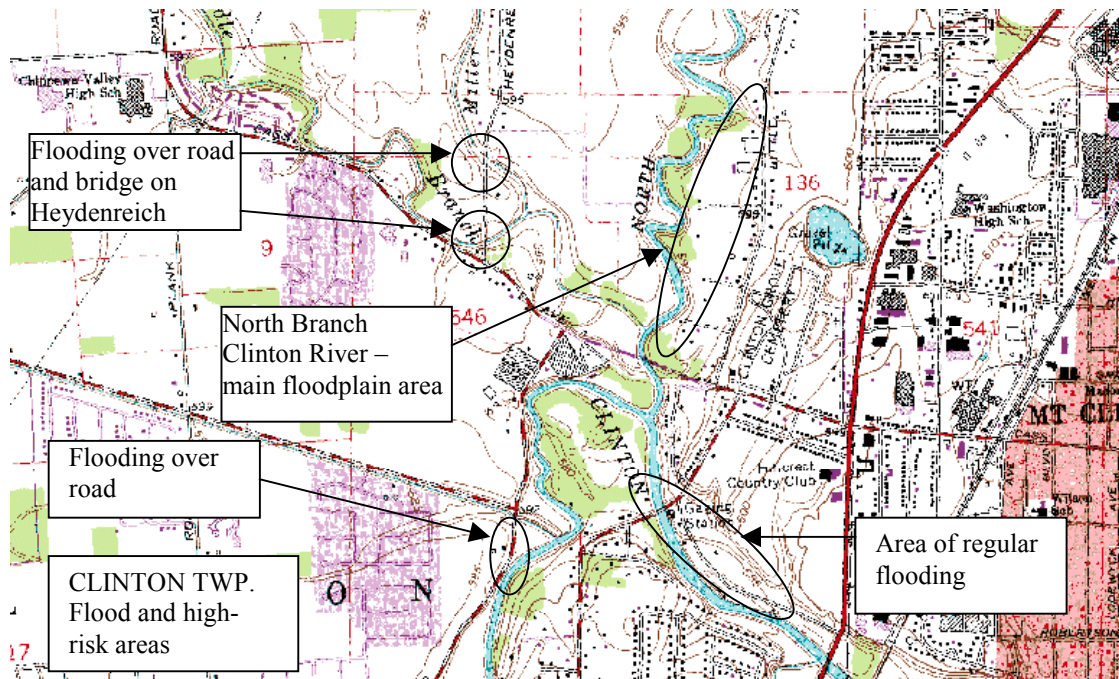
Sections 33-34 – The town of Washington has a string of buildings and houses alongside a drain that are considered by the FIRM to be in a 100-year floodplain. A post office, commercial structure, and seven homes are at least partly located in this floodplain area. (Four other houses in this area were assessed by local officials as not at-risk, but the drain seems to be receiving some illicit fills that are an extra burden on its capacity.) Southeast of town, east of M-53, is a drain going through a residential area and causing some flooding problems. An area with condominiums experiences street flooding, and some

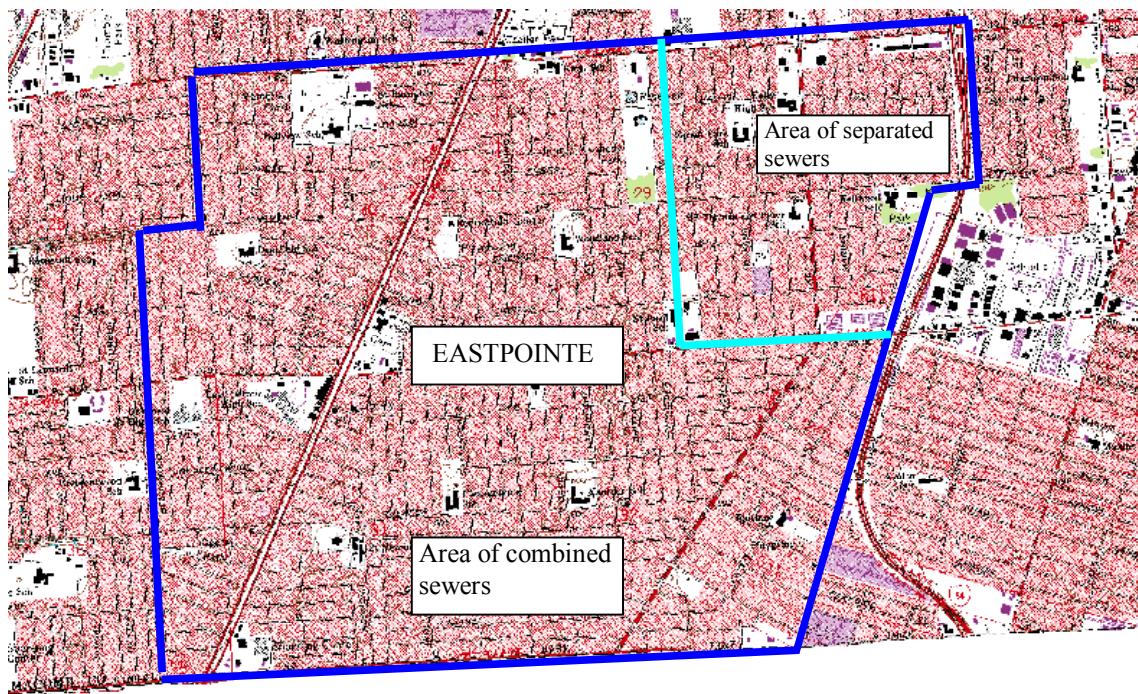
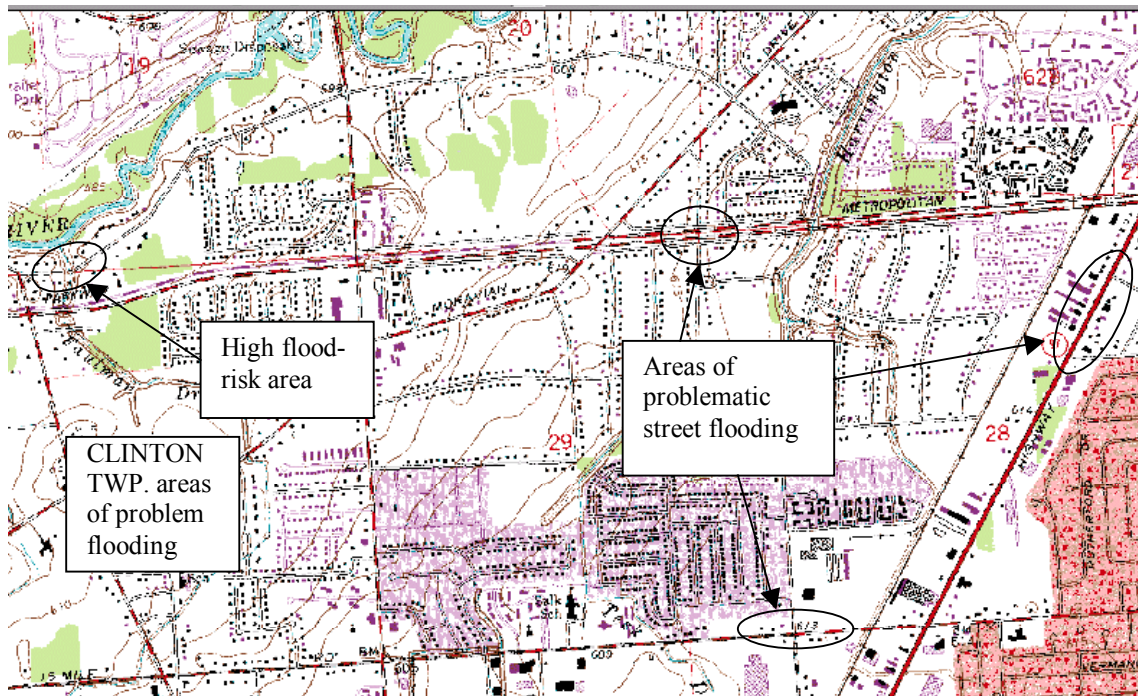
units of a mobile home park are directly affected by these waters. Due to elevations, not much damage has been observed there by local officials, but the skirtings are affected. (third priority)

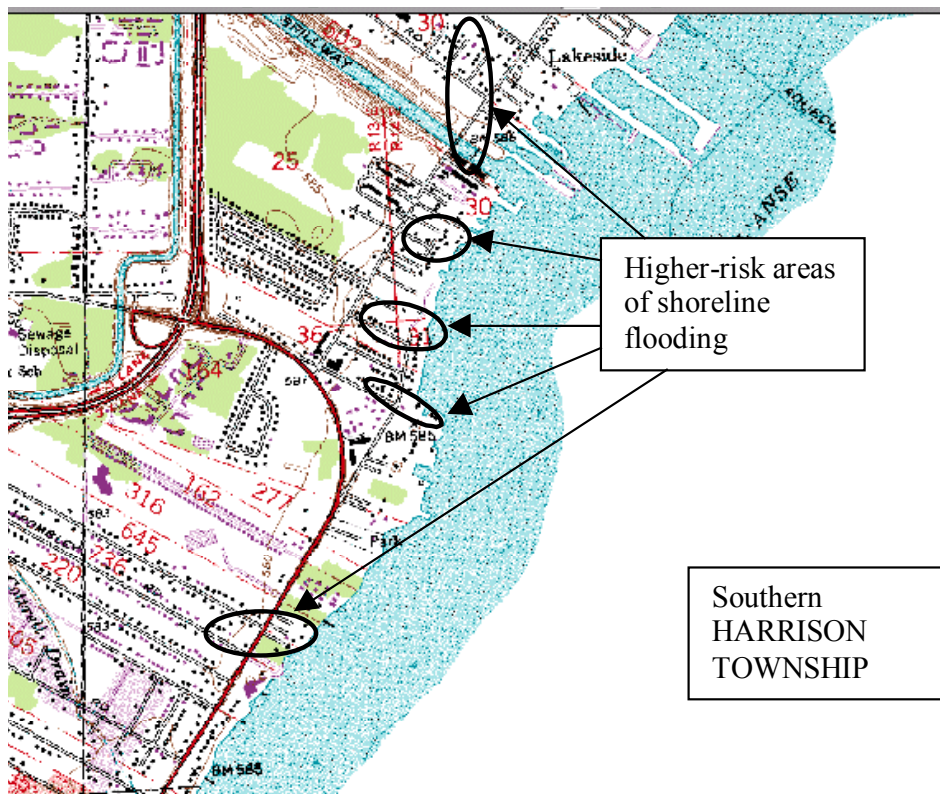
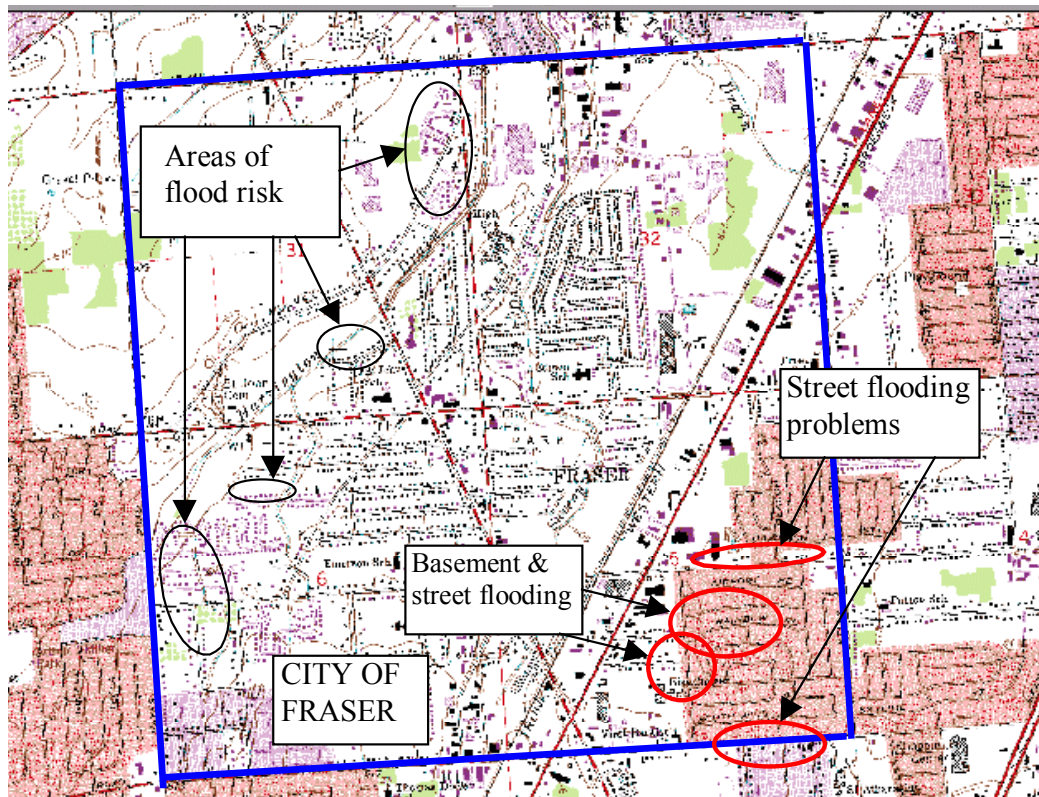
In summary, there is an area in the township with serious street flooding and two homes that have suffered basement flooding. (second priority) At least 12 structures are located in 100-year floodplain areas in the township, and other areas of street flooding have been noted. (third priority) It was also found that three more structures are located in lesser-risk floodplains. (last in priority)

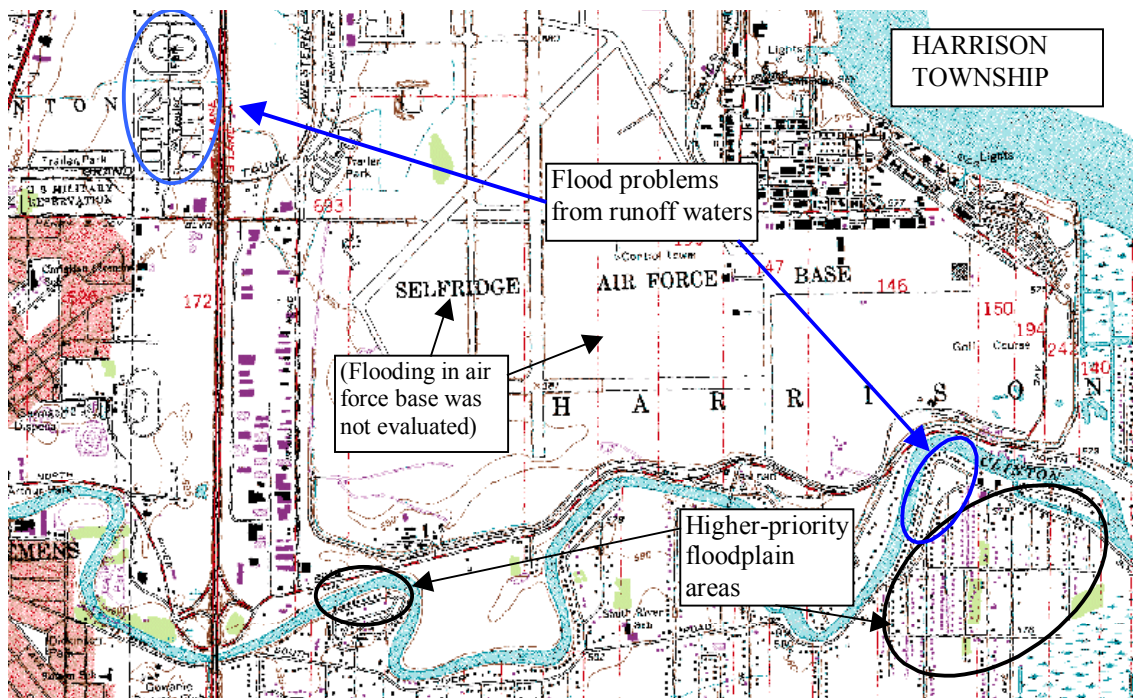
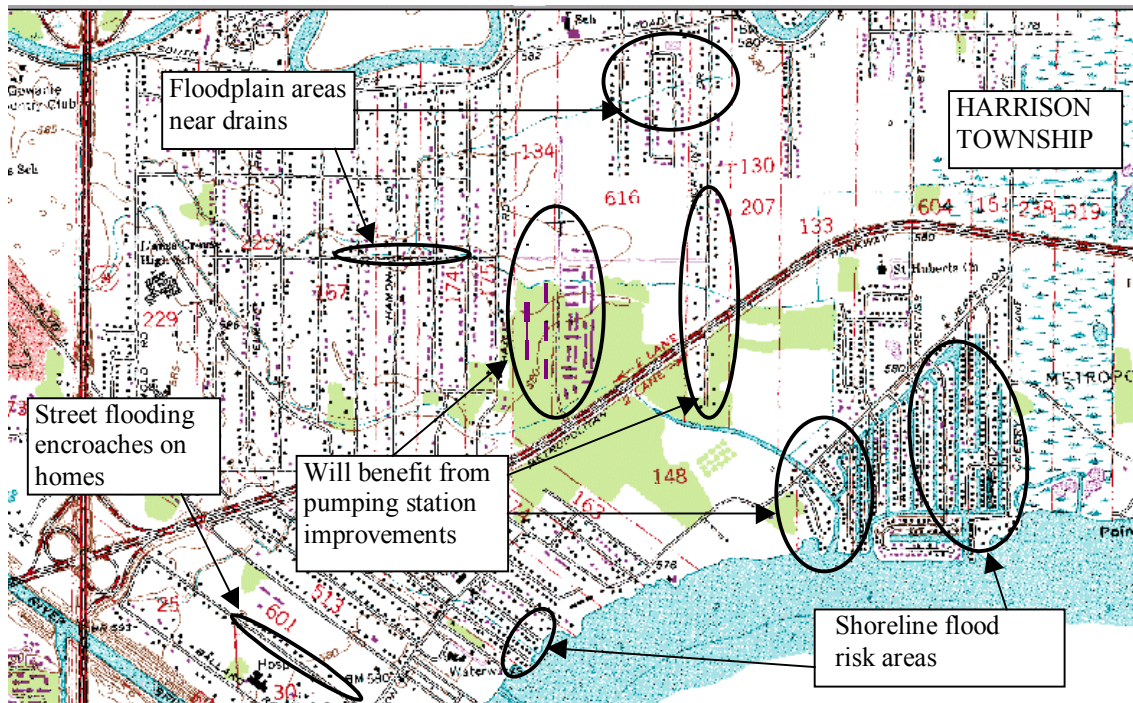


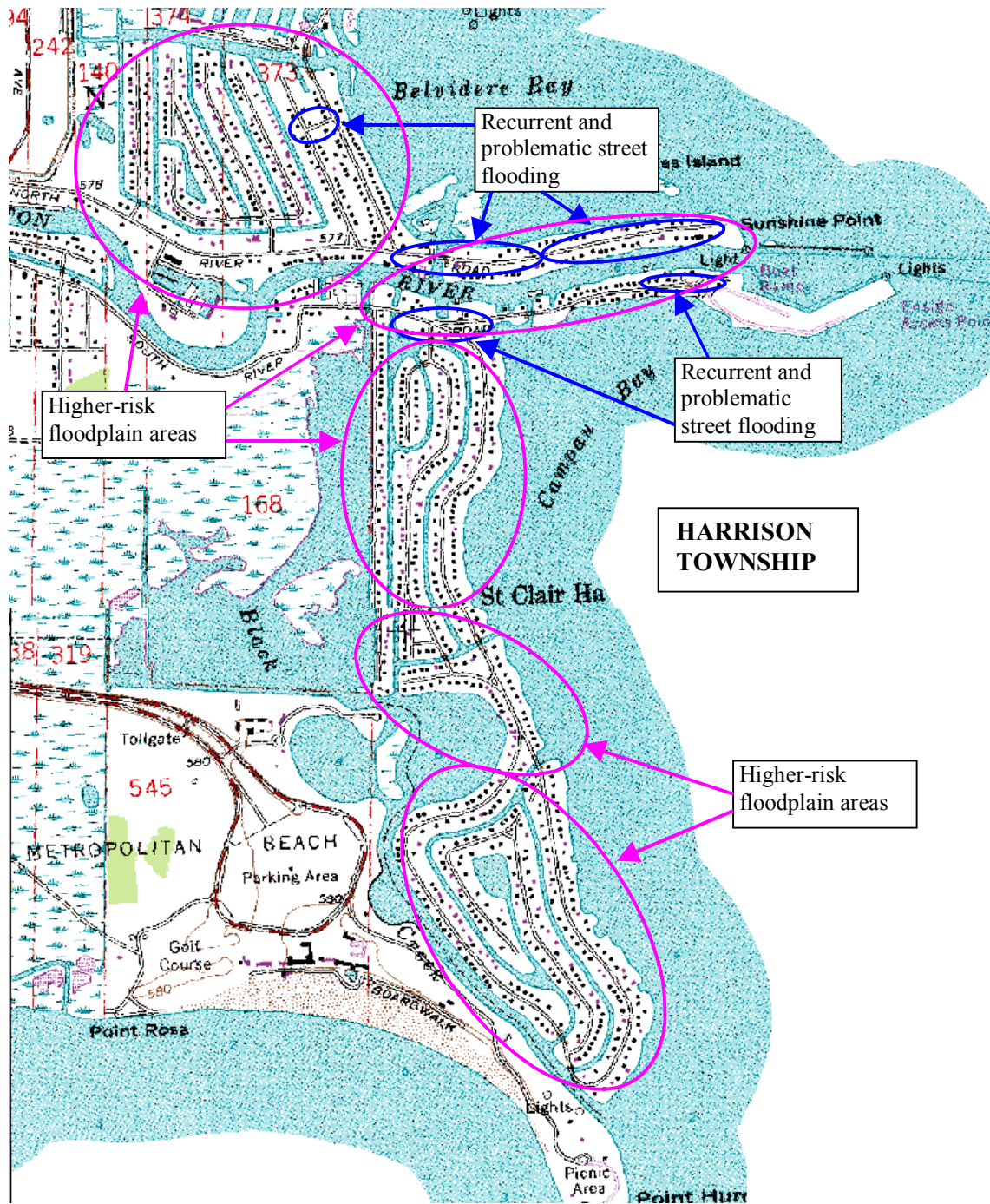


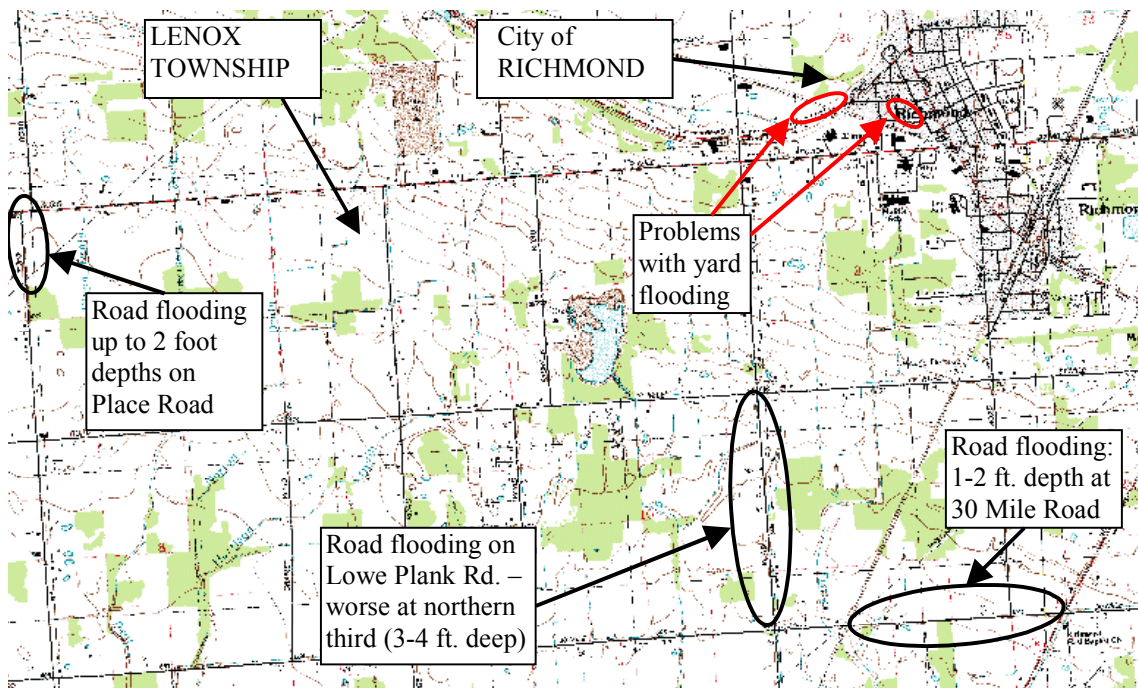
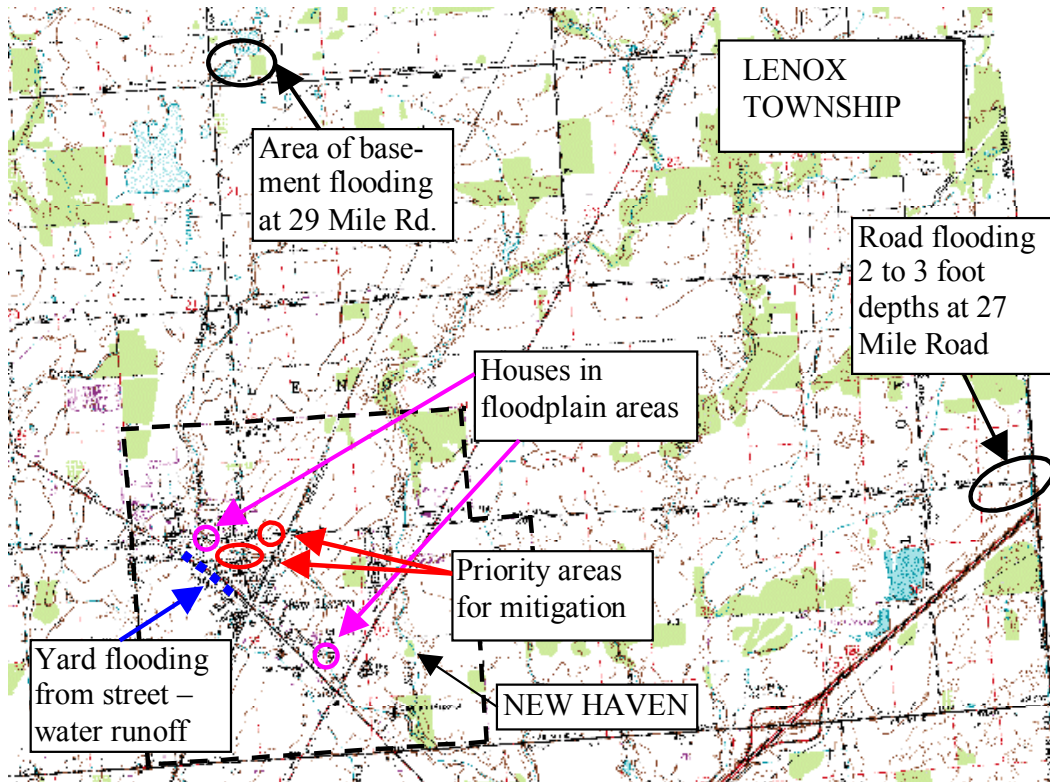


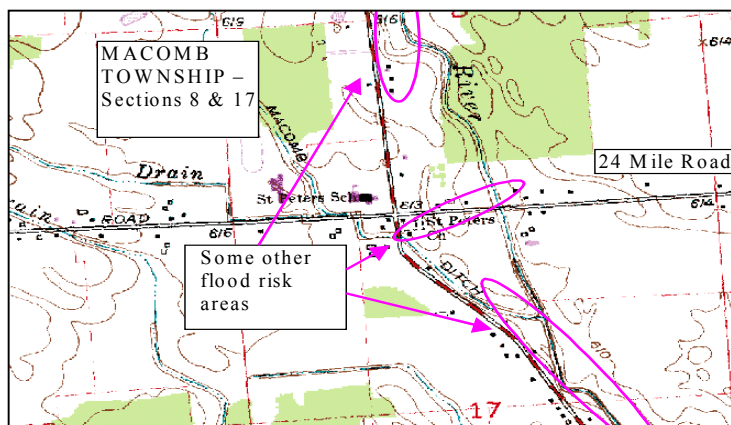
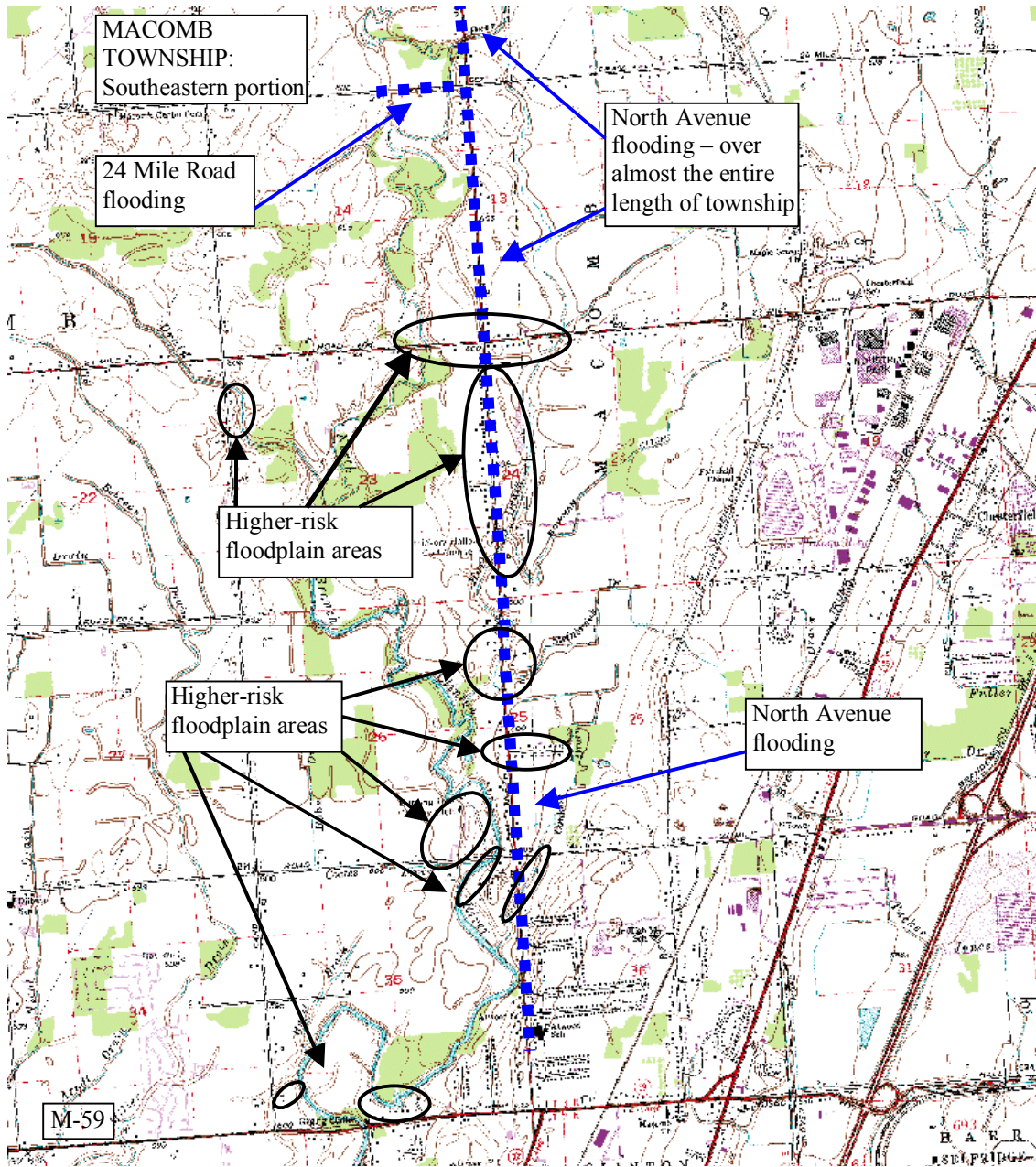


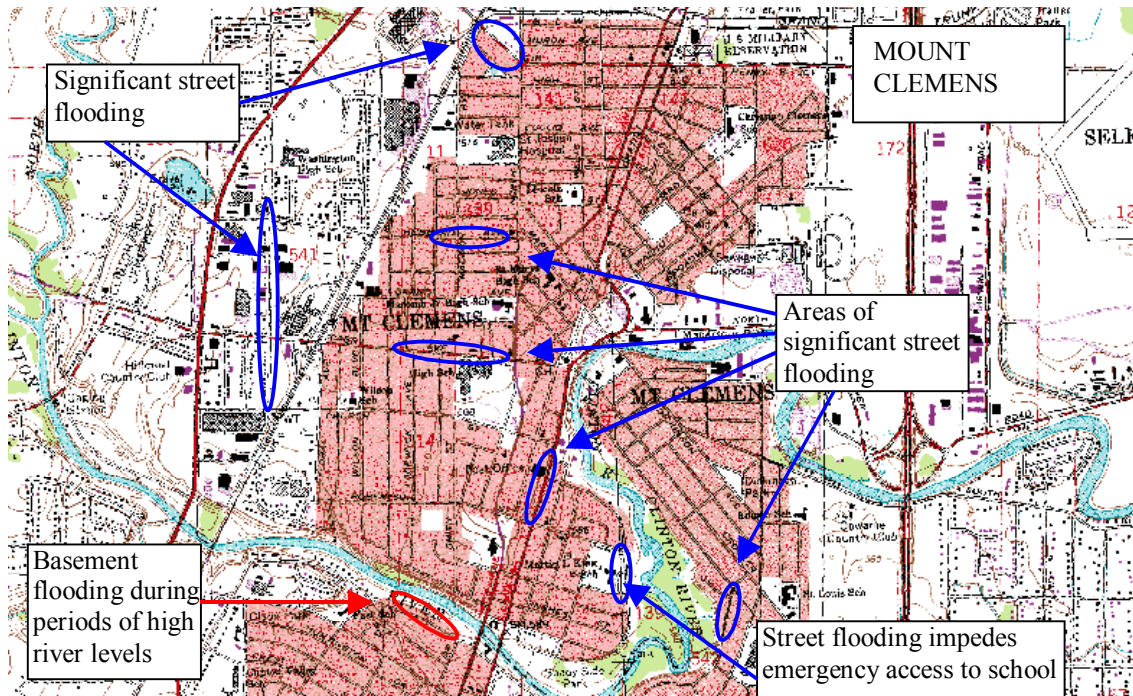


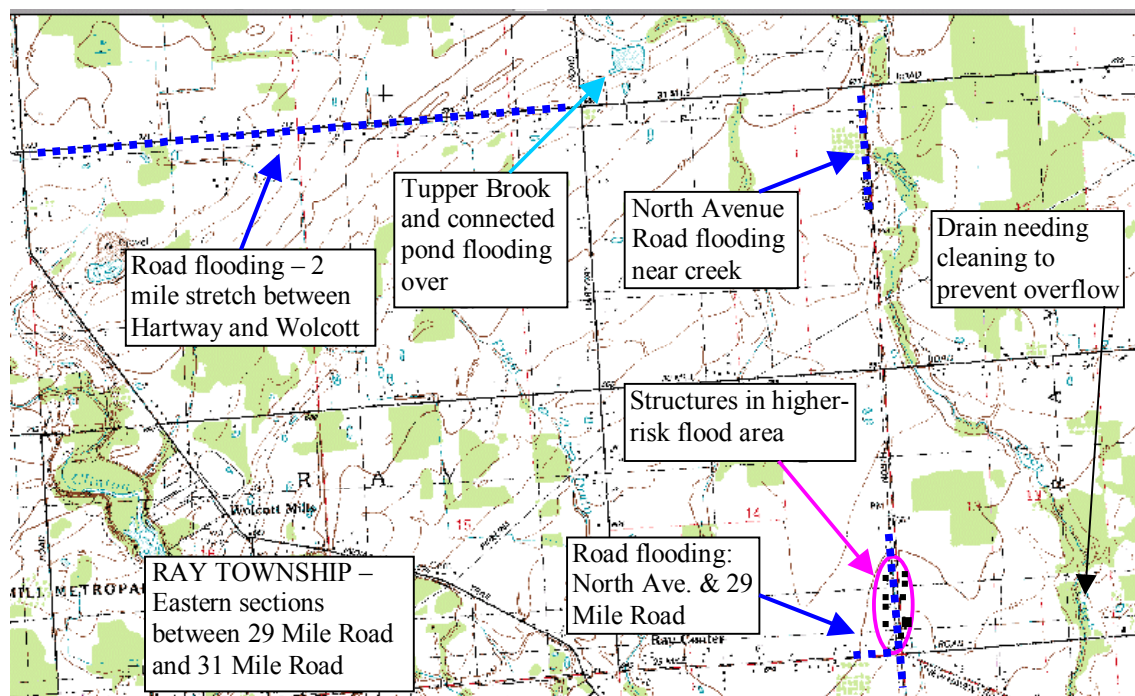
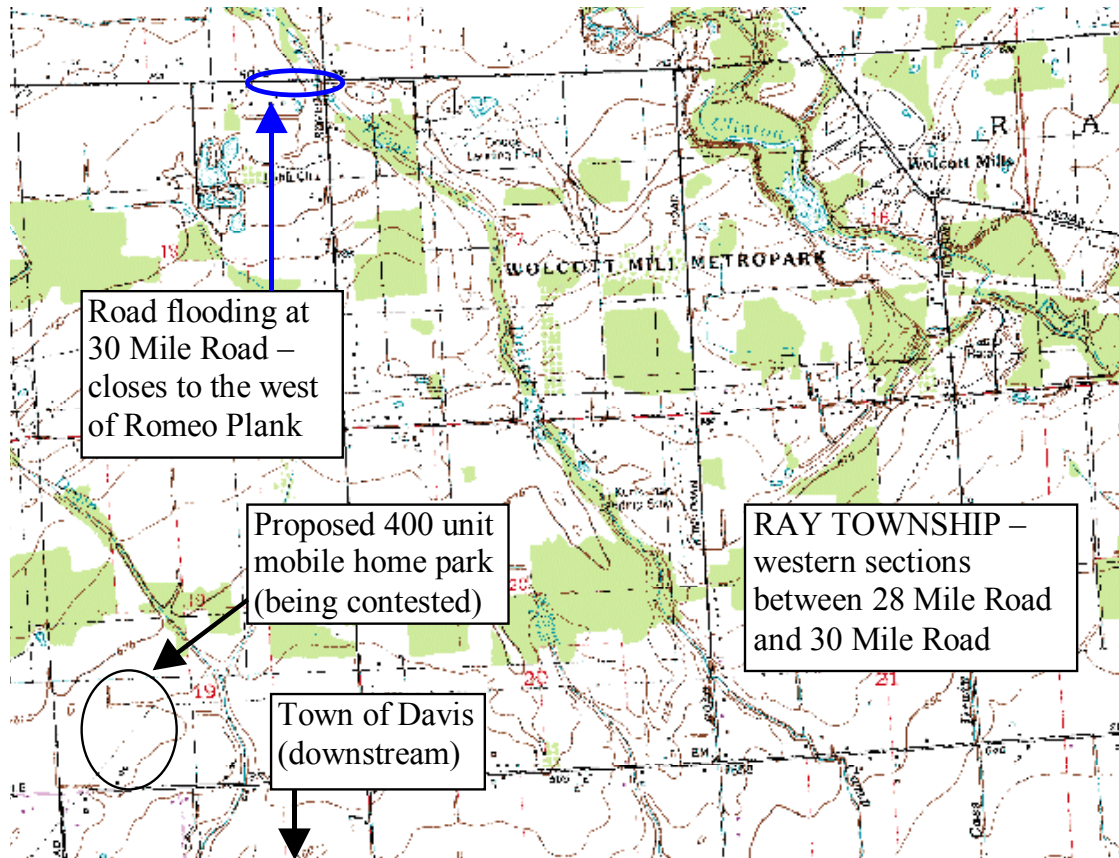


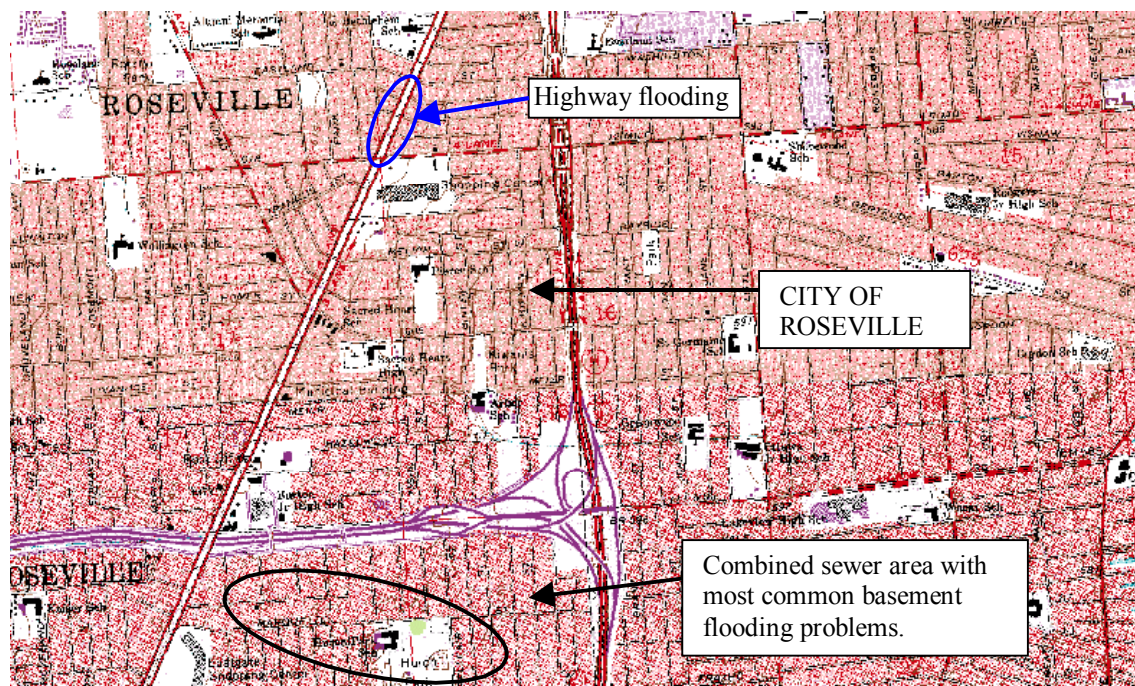
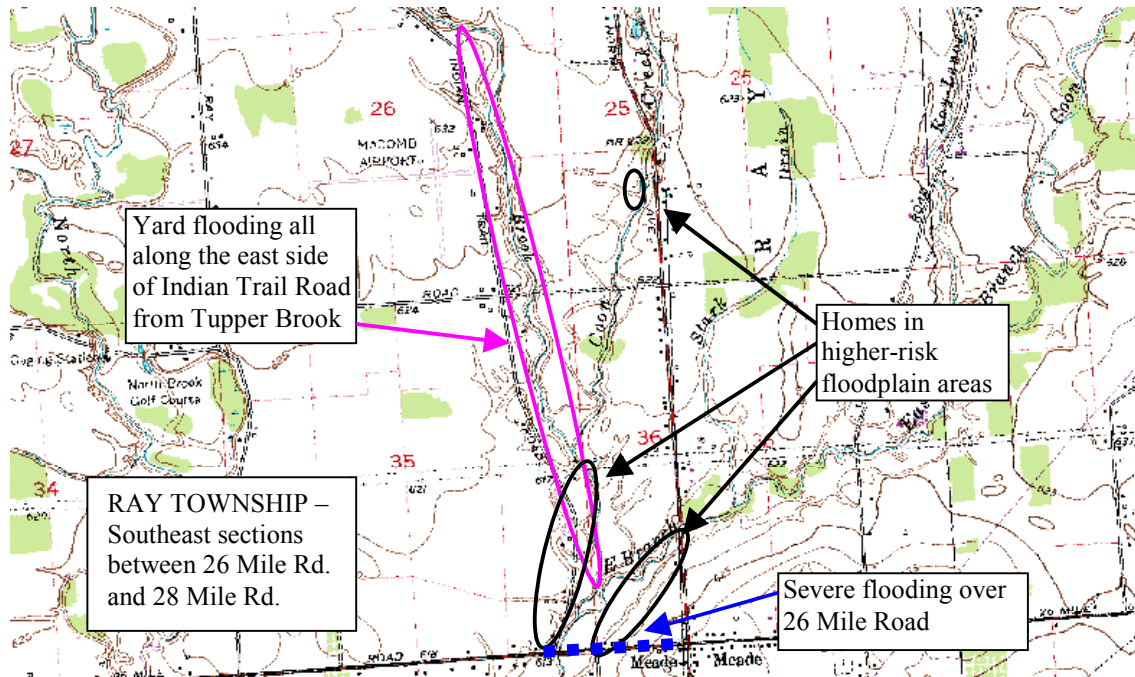


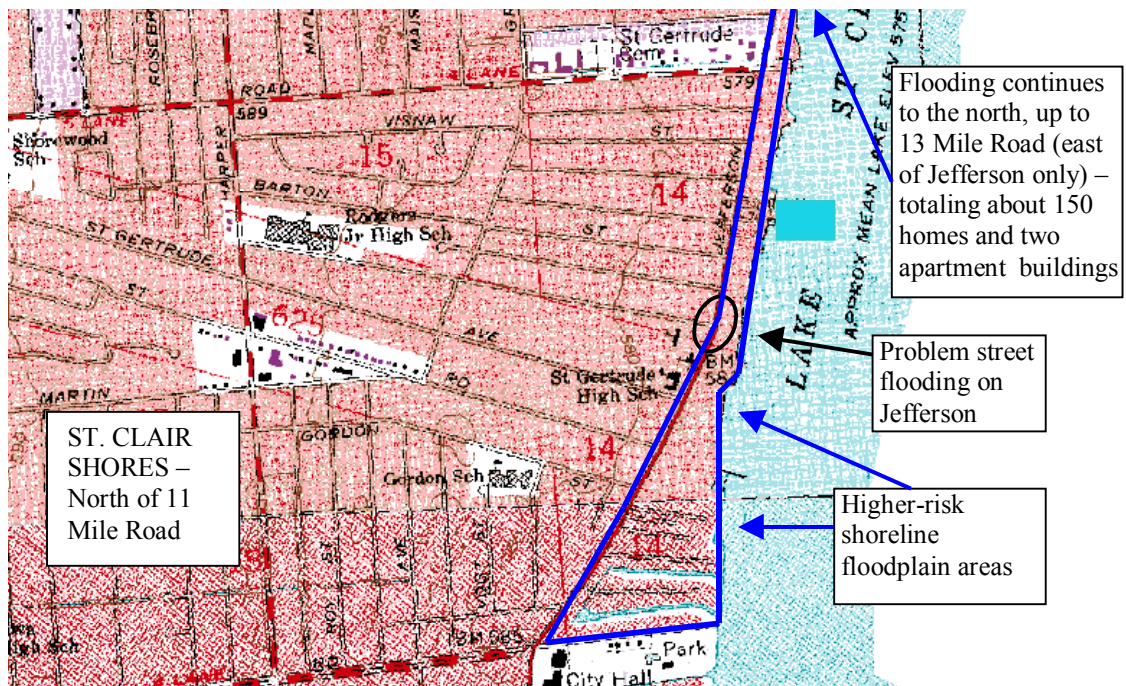
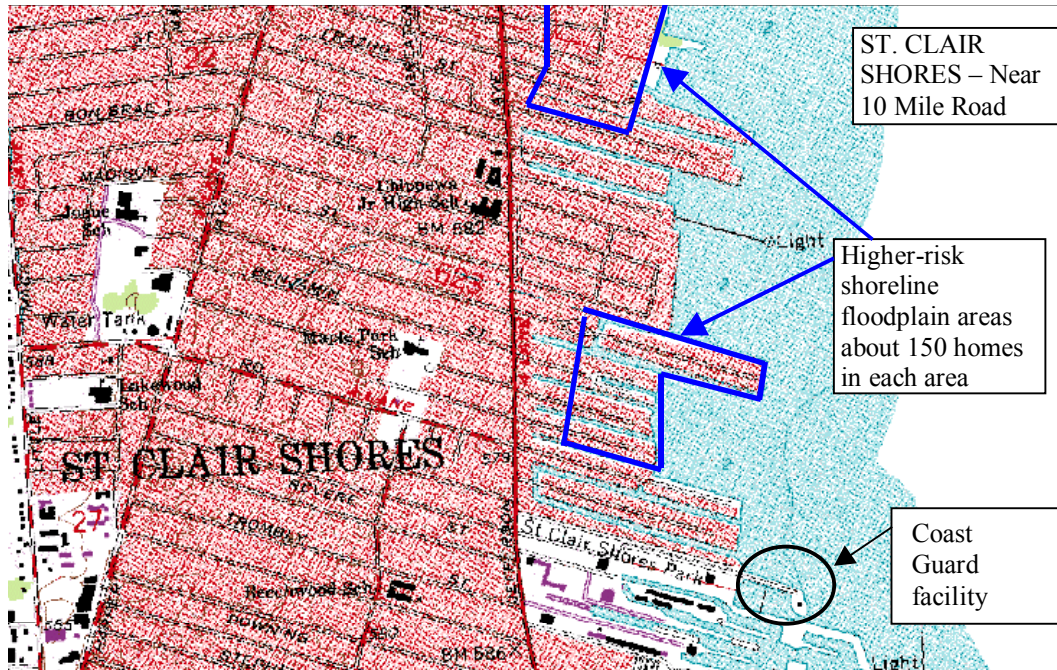


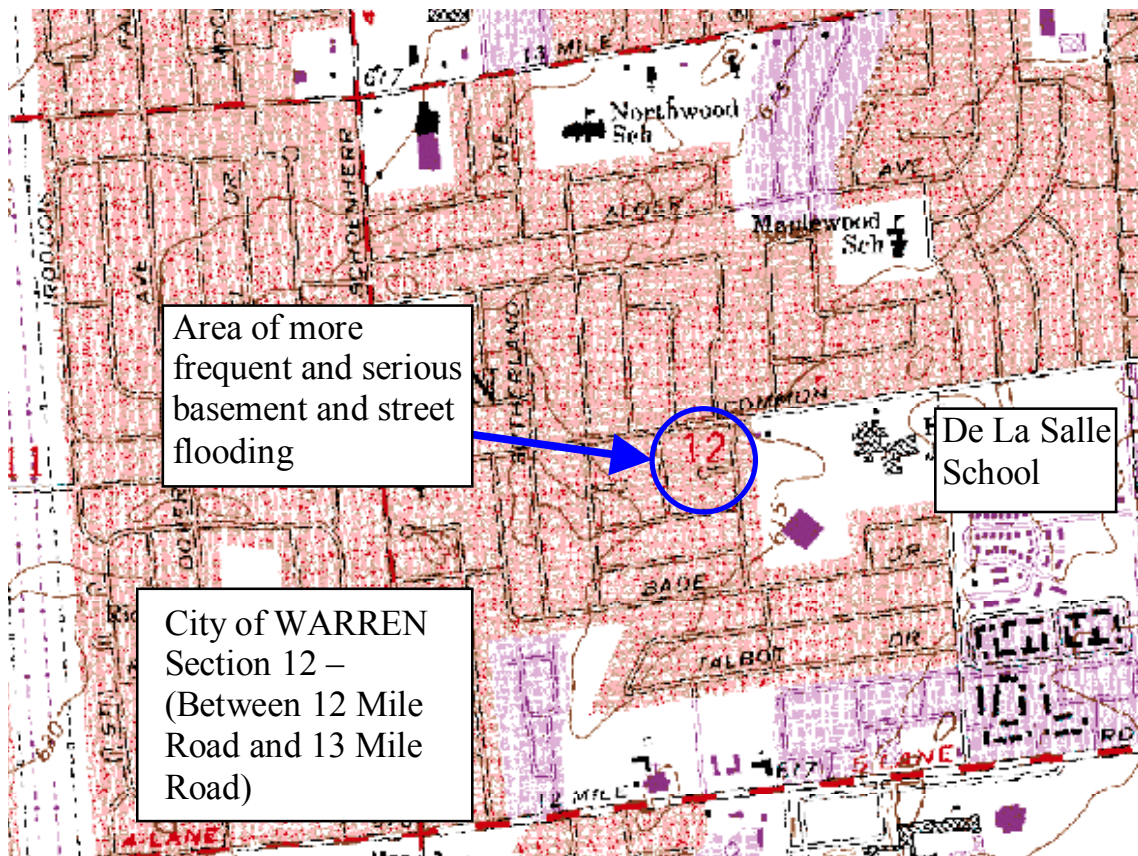
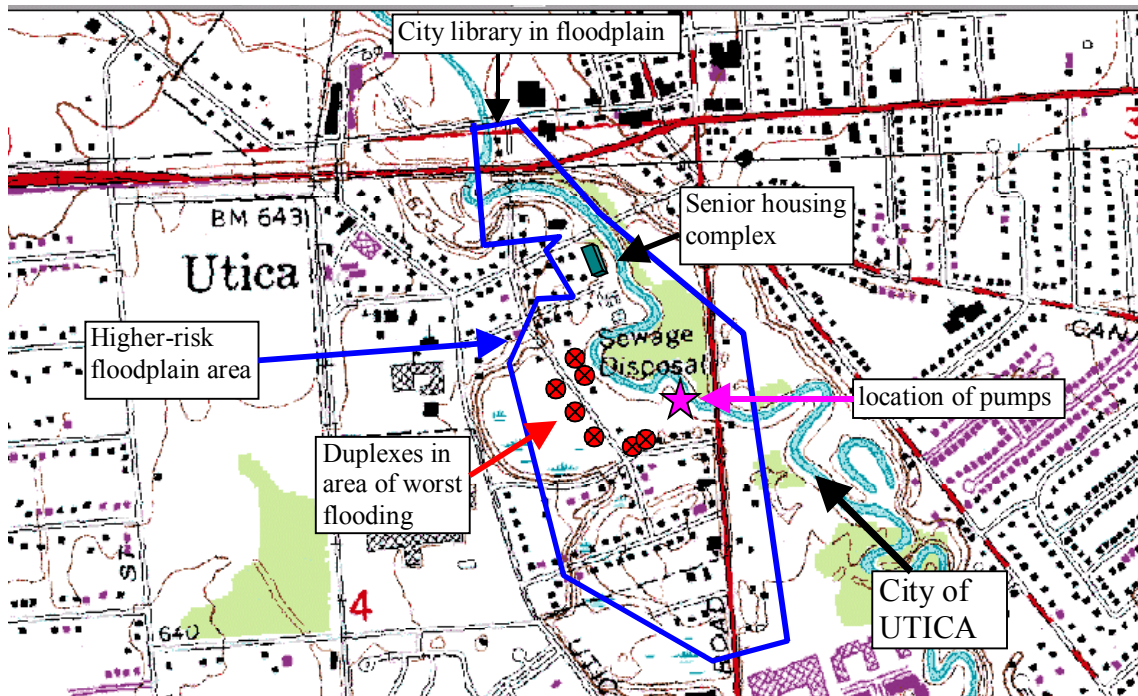


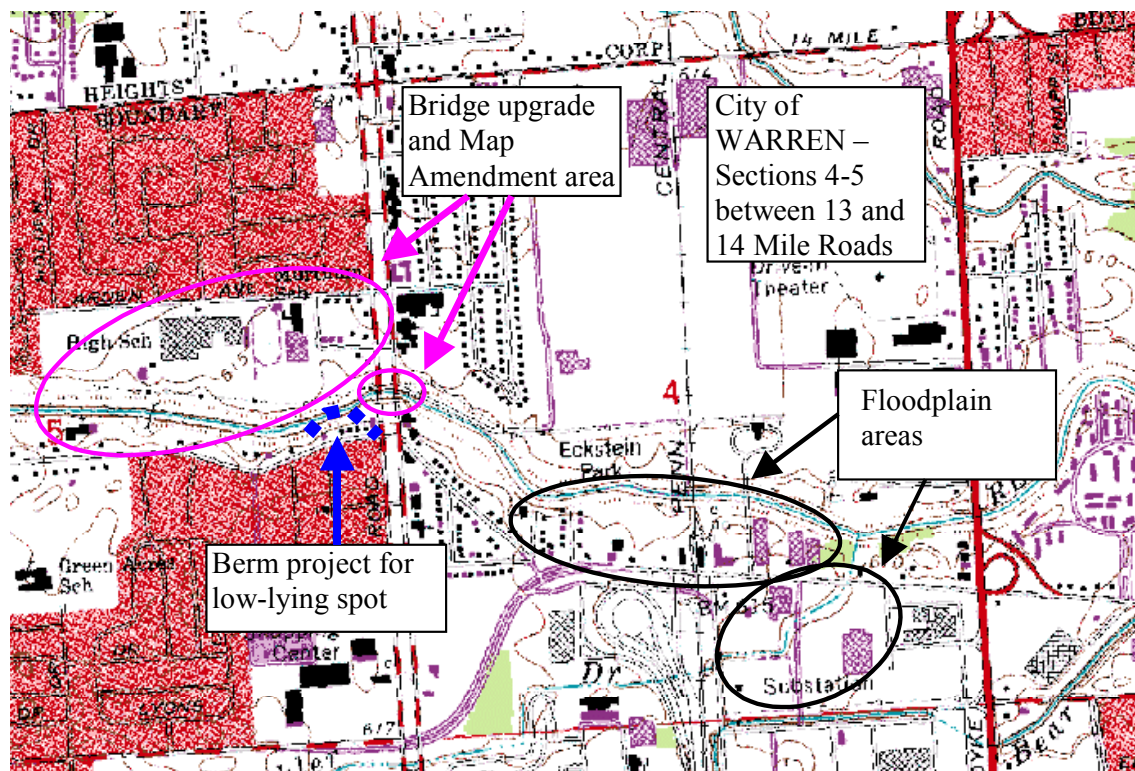
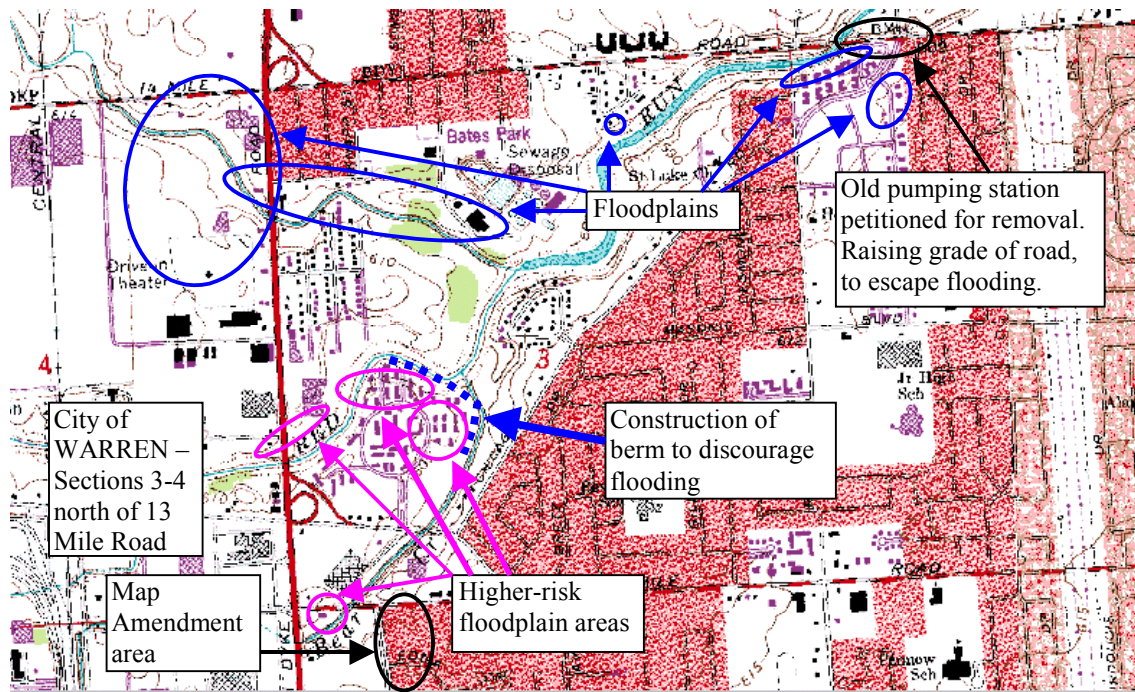


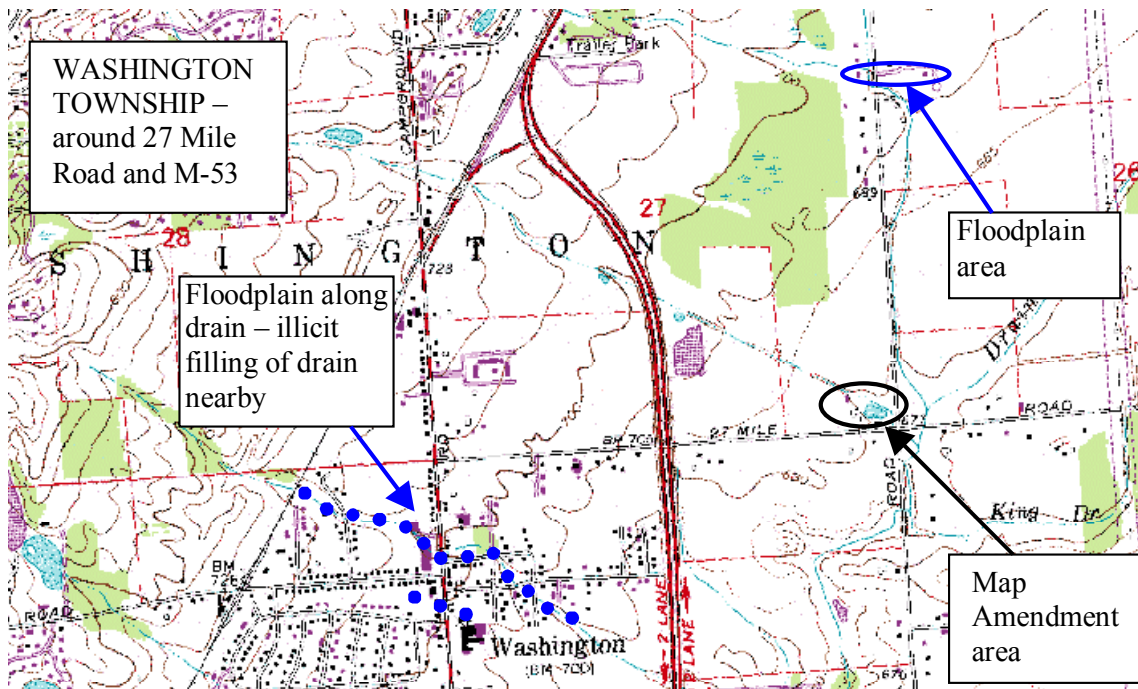
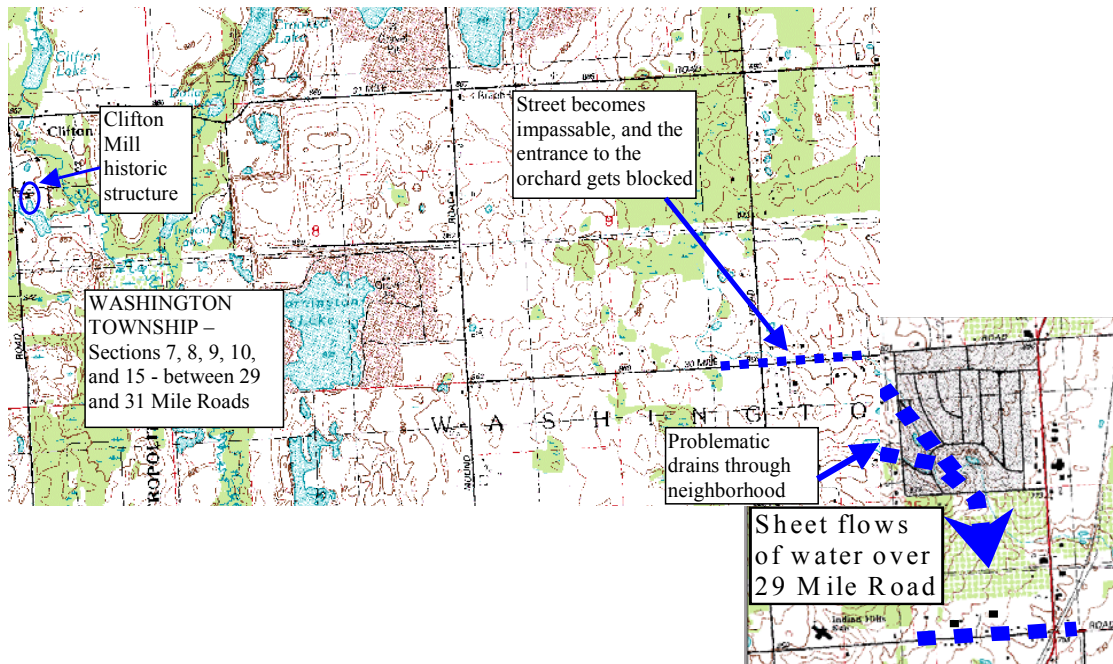












County Summary of Flood Vulnerabilities

Macomb County experiences flood damages from shoreline, riverine, and urban flooding. Top priority has been given to more than a dozen structures identified by the NFIP as suffering repetitive flood losses, and the areas in which they are located. Second priority has been given to the estimated 1,774 structures in floodplains that are known or assumed to have suffered recent damages from flooding. Third priority has been given to the estimated 2,378 structures in 100-year floodplains that have not had known damages reported to local officials. Last in priority are the estimated 2,752 structures located in lesser-risk floodplain areas. Numerous areas of street flooding and infrastructure problems have been assessed and similarly prioritized according to the extent of their impacts.

Flood Management Goals

The major flood management goals in the county include the following:

1. Improve the county's planning and mapping capabilities to identify flood problem areas to mitigate flood losses and to encourage land use that would reduce flood losses.
2. Elevation or relocation of repetitive loss structures, or the acquisition and removal of these structures so that the land can function as open space or low-impact recreational uses for the community.
3. Maintaining or increasing the flow capacities of the county's drainage infrastructure, through debris clearance, dredging, erosion control measures, and engineered drainage improvements, as calculated to be appropriate and necessary to reduce flood risks.
4. Improving the capacity of sewer systems and their components so as to better handle runoff, rain, storm, and lake events of greater magnitude, with lessened negative impacts on area residents and their properties.
5. Rezoning of developed or developable lands that have a high risk or history of flooding, so that recreational or open-space uses are promoted, or substituted for intensive development. Clinton, Macomb, and Ray Townships have all done this kind of rezoning. Other communities shall also be encouraged to engage in such practices.
6. If this plan is adopted by State and Federal agencies, that local communities also adopt it, or portions of it, or plans that are consistent with it, to encourage mitigation of county flooding hazards.
7. Develop a post-disaster team to assess flood damage and to determine mitigation opportunities, in coordination with the Emergency Management Division.

Detail on Flood Management Goals:

1. Planning/Mapping

The Office of Emergency Management has been working with the County's Planning Department and the planning commissions of local governments to mitigate potential flooding problems in Macomb County. The following projects have been identified and are in planning stages, or in development, to mitigate hazards in Macomb County. Many of these projects affect not only Macomb County, but Southeastern Michigan and the Great Lakes Region as well. Descriptions of the projects include objectives, benefits, and location (areas affected). The County's Department of Planning and Economic is developing a Countywide Geographic Information System (GIS) For Disaster Mitigation and Emergency Response Planning. Through the development of a county-wide Geographic Information System, a tool set consisting of highly accurate electronic maps and databases, tied to exact locations on the earth surface, could be made available to county agencies and local communities as a disaster mitigation planning tool. Such a system could be used for:

- Identifying flood plain and shoreline areas prone to natural flooding.
- Inventorying potential sites for human-made disasters.
- Surface water modeling for flood control and stormwater management.
- Improving siting of new facilities such as schools, hospitals in lower risk areas.
- Identifying the spatial relationships between residential, special populations, potential hazards and emergency services.
- Emergency response planning and routing.
- Pre/Post disaster coordination and dispatching of intergovernmental emergency responders.

The creation of a county wide geographic information system with the ability to perform these functions requires the following elements:

- County wide aerial digital orthophotography to support development of:
 - Parcel map layer depicting location, land use, property value and ownership
 - Road centerline/address map layer depicting the locations of all roads in the county with their addresses for emergency services routing and planning
 - County-wide hydrography map layer depicting the locations of all water courses, flood control devices, storm water control devices and shoreline areas
 - County-wide topographic contour map for watershed modeling and flood response planning
- Computer hardware and software for development, analysis and distribution of above data/map sets consisting of:
 - High end file server for storage of data sets and digital orthophotography

- High end workstations for the development and maintenance of new and existing data/map sets
 - Workstations for performing queries and developing plans
 - ArcInfo® and ArcView® software for developing, maintaining and distributing data/map sets.
 - The first stage of this project will begin in spring of 2000 and continue throughout the decade.

Known changes to the official NFIP Flood Insurance Rate Maps should be reported in a timely manner to that organization by submitting Letters of Map Amendment (LOMA) to upgrade or downgrade the classification of property's and better represent existing flood risks. The GIS mapping capabilities can allow better quantification and representation of these findings and adjustments.

2. Structure-specific solutions

Many structures have locations in floodplain areas, with their first floor at a level below the base flood elevation for that area. Depending on the type of structure and conditions of its environment, different individualized solutions may eventually be proposed and implemented for each such structure that is at risk. Structures may be elevated so that the first floor is above base flood elevation. A structure may be moved to a new, less-vulnerable location. In other cases, a community may acquire the structure by purchasing it from its current owner. A purchased structure may be moved or demolished, and the land is then typically used in a way that is consistent with the flood-risks to which it is susceptible. It either is kept as open space or is re-developed with new uses, such as parkland, that occasional flood events will not significantly disrupt or damage. An accumulation of acquired properties kept at lower-intensity land use levels generally will help hold flood waters in future events and therefore render adjacent and downstream properties less vulnerable to runoff and flooding.

3. Clearing and upgrading drains, bank stabilization

The Macomb County Public Works Office Flood Mitigation Projects include the bank stabilization and existing channel modification of two miles of the Middle Branch of the Clinton River. This would provide a 100 year storm floodway flow improvements. This will also include blockage removal and bank flow characteristic improvements in Macomb and Clinton Townships.

The Public Works Office also identified bank stabilization, in Clinton Township, of approximately 2,000 feet of flood channel to improve bank and channel flow characteristics during 100-year storm flood events.

4. Sanitary Flood Mitigation

The City of St. Clair Shores has recently passed a bond issue authorizing repairs to their local sewer system. The local sewer systems within St. Clair Shores are composed of separated and combined systems. Flow from the systems is conveyed to four major interceptors: 1) the Martin Drain, 2) 9 Mile Drain, 3) the 8-½ Mile Drain and 4) the Jefferson Interceptor.

Two combined sewer retention treatment basins (RTBs), Martin and Chapaton, serve southern Macomb County. These RTBs were constructed in 1969 and receive excess flows from combined sewer areas during storms. The captured water is sent to the sanitary sewer system after the storm. During large storms, water will flow into the RTBs, receive primary treatment and disinfection and then overflow into Lake St. Clair. The Martin RTB has a volume of 8.6 million gallons. The Chapaton RTB has a volume of 28 million gallons. The Martin RTB serves the area tributary to the Martin Drain and the Chapaton RTB serves the area tributary to the 8-1/2 and 9-Mile Drains. The Jefferson Interceptor serves as the direct outlet for most of the separated sewer system in St. Clair Shores and the outlet for the sanitary and combines flows from the Martin and Chapaton Districts and the RTB dewatering outlet.

Ever since 1994, Lake St. Clair has experienced high bacteria levels, which has caused the closing of public beaches for swimming. During periods of heavy rainfall, basements are repeatedly flooded. The sanitary system as it presently exists does not fulfill the needs of the community. It is overburdened because it has been outgrown.

Pump Stations Improvements

The City of Fraser has identified a problem with its sanitary sewer overflow discharge point at its Beacon Pump Station located at Beacon Lane and Masonic. During periods of heavy rains, sanitary sewage is allowed to enter the storm sewer. This is the same storm system that goes into the Clinton Drain and then into Lake St. Clair, which relates to the health and safety issues at hand. If this sewage is not permitted to go to the storm sewer, the basements of the residents in the area will flood.

Action to amend this situation is highly recommended. It would involve the installation of valves to ensure that pumps discharge to the sanitary sewer system.

Chesterfield and Clinton Townships have identified similar problems with pump stations. Chesterfield's Schmidt Pump Station and Clinton Township's Bridgewood Pump Station requires improvements to prevent urban flooding.

Clinton Township is presently planning a \$30,000,000.00 improvement to its sanitary sewer system. Work is to begin in the spring of 2001.

5. Redevelopment and Zoning

Clinton and Macomb Townships have re-zoned flood-prone areas in their respective townships for recreational use. Clinton Township has purchased property and developed a park system for their residents' use while allowing a passive water detention to co-exist. Clinton Township is presently developing a recreational site, in a flood-prone area, at Clinton River Road and Canal Road and is seeking Federal recognition as a historical site.

Macomb Township has zoned the flood-prone areas along the North and Middle Branch of the Clinton River for use as golf courses. This mitigation technique allows for recreational use of flood prone areas while increasing property values around these areas.

In the northern portion of Macomb County, the Emergency Management Office is working with community leaders to redevelop areas that are located within the flood plain. The direction is toward developing potential flood-prone property into recreational use. Creation of a regional park has taken place along with the development and planning for recreational facilities such as golf courses.

6. Coordination of Mitigation Efforts

This analysis and plan has been written with input from all communities within Macomb County's Emergency Management area, and is intended to coordinate with the plans and programs of local and smaller-scale entities within the County.

7. Post-Disaster Response Team

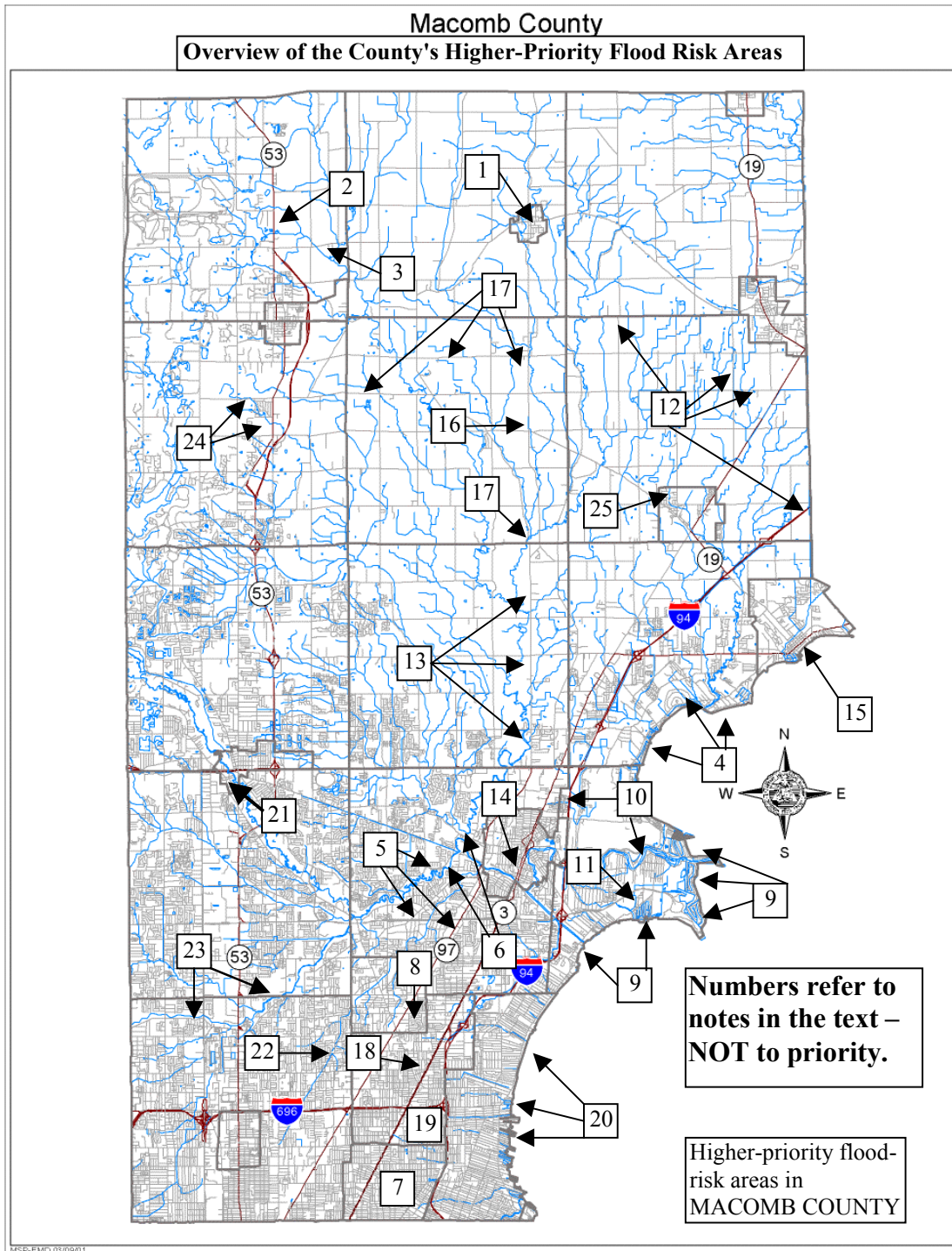
The Macomb County Emergency Management Division has initiated training programs to assist local communities in assessing damage caused by floods. The courses were conducted for local community assessors. A training program to identify mitigation opportunities is under development for local community planners.

Highest Priority Areas of Vulnerability **Summary Map**

A summary map of all the highest priority areas of vulnerability (mainly those classified as first and second-priority in this report) appears on the following page. **THE NUMBERING BELOW IS NOT IN ANY SPECIFIC ORDER AND SHOULD NOT BE INTERPRETED AS REPRESENTING PRIORITIES IN THIS PLAN.** The next section will assess more specific areas of vulnerability in terms of prioritized mitigation needs. Numbers appearing on this map are given only to match up with the following brief descriptions:

1. An at-risk house in the Village of Armada, which has ponding water regularly coming right up to it.
2. Bruce Township road flooding over M-53.
3. Bruce Township homes with basement flooding and nearby floodwaters regularly approaching them.
4. Chesterfield Township areas with high flood risks from riverine and shoreline flooding, including structures with repetitive damages. See the Chesterfield Township section of this document for more details.
5. Clinton Township areas of road flooding. See the Clinton Township section of this document for more details.
6. Clinton Township higher-risk floodplain areas. See the Clinton Township section of this document for more details.
7. Eastpointe area of combined sewer system with higher potential of basement flooding.
8. Area of regular basement and street flooding in Fraser.
9. Harrison Township's extensive high-risk shoreline flooding areas. See the Harrison Township section of the document for more details.
10. Harrison Township areas of flood problems from runoff waters.
11. Harrison Township area that will benefit from pumping station improvements. See the Harrison Township section of the document for more details.
12. Areas of severe road flooding in Lenox Township.
13. Severe and recurrent road flooding along North Avenue in Macomb Township.
14. Flooding on a major road in Mount Clemens.
15. New Baltimore high-risk shoreline flooding area.
16. Ray Township road flooding on North Avenue north of 29 Mile Road, threatening nearby structures.
17. Other areas of serious road flooding in Ray Township.
18. Road flooding on major highway in Roseville.
19. Roseville combined sewer system area with greater likelihood of basement flooding.
20. Various higher-risk areas of shoreline flooding in St. Clair Shores. See the St. Clair Shores section of the document for more details.
21. Area of serious flood problems in the city of Utica.

22. Area of more frequent and more serious basement floods in Warren.
23. Mitigation project locations in Warren: berm construction, removal of pumping station, and raising grade of road.
24. Area of road flooding, major sheet flows of runoff water, and basement flooding in Washington Township.
25. Houses in the floodplain areas of New Haven.



DETAILED PRIORITIZATION OF HAZARD AREAS FOR MITIGATION PROJECTS

(FMA and/or other pertinent funding sources are identified in the descriptions below)

As described in a previous section (on pages 3-6), identified hazard areas have been broadly classified into four different levels of priority. It is necessary to further assess the risks and hazards facing some areas that have been assessed as "second priority," along with some of those that were categorized as "third priority." This section contains an assessment that also suggests the priority that should be given to specific mitigation projects that the hazard analysis has identified as being top priority or second priority. Not all of the listed projects will be appropriate for funding from the Flood Mitigation Assistance Program, but are included anyway because they are important to alleviate current or potential flood problems in the county. **THE NUMBERING BELOW IS IN ORDER OF PRIORITY AND IS BASED ON THE NUMBER OF STRUCTURES AT RISK, AND FLOOD DEPTH / RISK LEVELS AFFECTING THOSE STRUCTURES.** Projects that do not involve specific structures will be listed afterward. Although the projects are listed in order of priority, some of them may be easier to implement than others, and so the numbered priorities do not necessarily imply that mitigation projects should or will occur in precisely the numbered order listed here. Rather, actual project implementation will depend on gaining the approval of stakeholders, identifying specific factors to implement mitigation actions, and demonstrating that the costs of mitigation actions will be less than the benefits that result for the community/ies involved.

PROJECT 1: In the northwest part of Harrison Township (see page 16) is a manufactured home park that experiences regular and severe problems with urban flooding. There are about 300 units in the park, and about 270 of these units are regularly affected by the flooding. It is a very flat area in which runoff waters flow from uphill, and an undersized drain that backs up, have caused as much as 2.5 to 3 feet of floodwaters to accumulate throughout the park. The community is a participating NFIP member, and the County Public Works Department is also eager to solve this problem. Although the area was designated in a lesser-risk floodplain (Zone B), county officials currently consider this the most important mitigation project in the county. (The meaning intended on the FIRM by the Zone B designation is not perfectly clear, as its description includes areas that regularly suffer flooding so long as the flood depths are less than one foot.) An engineering study for Irwin Drain improvements has been completed and the project awaits suitable funding. The map shown here was reprinted from that study. For more information on this project, please refer to the document prepared by Hubbell, Roth & Clark, Inc. for the Macomb County Public Works Commissioner. The document is entitled "Irwin Branch Drain Improvement Project: Phase 1 – Drainage Improvement Study," and was dated December 1999 (final).

Alternative mitigation strategies: The document presents and analyzes alternative strategies to reduce flooding problems in this area, including channel cleaning, an increase in existing drain capacity, replacing nearby culverts with larger capacity concrete box drains, and/or installation of a pump station/detention pond. The document recommends drain cleaning, deepening and widening, at an estimated cost of \$1,970,000.

Potential actors: Partners that might be involved in this project could include the Macomb County Road Commission, State of Michigan Department of Transportation, Grand Trunk Western Railroad, and the townships of Clinton, Chesterfield, Macomb, and Harrison.

Potential funding assistance: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, Michigan Department of Transportation, Community Development Block Grant Program (if mobile home residents qualify as moderate or low-income), local sources, foundations, nonprofit organizations, or corporate giving programs.

PROJECT 2: On the south side of the City of Utica (see page 26), there is a floodplain area (Zone A6) in which flood waters get quite deep and cause damages to 7 duplexes that are located there. These duplexes (plus 3 houses) were recently proposed for elevation projects under the Hazard Mitigation Grant Program. Estimates of 100-year flood depths have been made for these structures, and measure between 5 and 6 feet for all the duplexes! Flood depths for 10-year events have been measured at the 2 to 3 foot level. There is a senior building with three stories and parking underneath it, and flood waters affect this parking, and elevator equipment that is located on the lowest level, which significantly impedes access to and from the building. About 51 other homes and 4 buildings are also in 100-year floodplain areas around this area (including the city library), but priority must be given to these structures that are regularly being impacted by severe flood problems. The community is a participating NFIP member.

Suggested mitigation strategies: Elevation of affected structures, elevation of elevator equipment in senior building, use of sump pump in parking level of senior building. Drain improvement and bank stabilization activities (see page 31) should also have a beneficial effect.

Potential funding assistance: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners.

PROJECT 3: In Section 35 of Macomb Township (see page 21), four houses in a floodplain area (Zone A7) are proposed for elevation so as to avoid future flood damages. The structures will be elevated 4 to 6 feet, once sufficient funding is obtained and applied. The community is a participating NFIP member.

Suggested mitigation strategy: elevate structures above base flood elevation.

Potential funding assistance: Flood Mitigation Assistance Program, local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners.

PROJECT 4: In Section 32 of Chesterfield Township (see page 11), there is a canal south of Field Street which has about 9 nine homes and 3 commercial buildings near it that have been heavily affected by flooding during periods of high water levels along Lake St. Clair. In 1985 and 1986, flood waters reached depths of 6 to 12 inches around the homes. The commercial buildings are located where the canal meets the Lake Waters. They are a party store, a marina office, and a gas dock, and they suffered floodwaters that were up to 18 inches deep. Much of the area is identified as a 100-year floodplain (Zone A3). Although some of the houses were classified with a lesser floodplain designation (Zone B), the key on the FIRM document was rather unclear about what the designation really meant for the area. I believe the Zone B classification here refers to an area subject to 100-year flood events of less than one-foot water depths. The community is a participating NFIP member.

Possible mitigation strategies: As an area of shoreline flooding, some sort of flood wall project might be most cost-beneficial to protect against storm surges. Canal redesign ideas might also be explored. Some houses could be elevated. A new pump station project (see page 32) should greatly help alleviate flooding to the at-risk properties along Jefferson Avenue.

Potential funding assistance: Home elevations could be handled by the Flood Mitigation Assistance Program or Hazard Mitigation Grant Program. Flood wall and engineering options might be explored by the U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners or businesses (also business associations or economic development funds) might also be used to assist with project funding.

PROJECT 5: Just northeast of Project 4 (in section 32 of Chesterfield Township—see page 11) is a 100-year floodplain area (Zone A3) along a canal, with about 11 houses (including one of the NFIP's identified repetitive-loss properties) that experienced flooding of 6 to 12 inches in the 1970s. Pumps and sandbagging were needed during the 1980s to reduce damages. The community is a participating NFIP member.

Possible mitigation strategies: The repetitive loss property might be acquired; elevations of flood-prone structures might occur; the canal might be re-engineered to discourage flooding. A new pump station project (see page 32) should greatly help alleviate flooding to the at-risk properties along Jefferson Avenue.

Potential funding assistance: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, re-engineering options possibly researchable by the U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be used to provide needed funding.

PROJECT 6: As mentioned in the description for Project 4, in the vicinity of the shoreline of Section 32 of Chesterfield Township (see page 11), the meaning of the Zone B flood designation has been interpreted as indicative of areas that

suffer 100-year flooding of less than one foot of water depths. There are about 106 houses located east of Jefferson and south of Farwell that are in this significant risk category, with 2 to 4 inches of floodwaters in the houses in the 1970s, and sandbagging efforts required since then to reduce damages. The community is a participating NFIP member.

Possible mitigation strategies: The repetitive-loss property could be acquired or elevated. Some engineered solution might be found for canal redesign to discourage overflow waters from flooding the roads and houses nearby.

Potential funding assistance: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, re-engineering options possibly researchable by the U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might also be able to provide needed funding.

PROJECT 7: In Section 28 of Chesterfield Township (see pages 10-11), southwest of Cotton Road, is a shoreline area with about 13 homes that has experienced flooding from Lake St. Clair. These houses are in an identified 100-year floodplain area (Zone A3) and flood depths have been as much as 6 to 8 inches in these homes. During the current period of low lake levels, mitigation actions should be taken to prevent further flooding when lake levels rise again. The community is a participating NFIP member.

Possible mitigation strategies: an existing dirt berm, and emergency sandbagging efforts, might be replaced with a more permanent flood wall structure to protect houses from shoreline flooding during periods of high lake levels and storm surges. The repetitive-loss property could be acquired or elevated. Canals would probably also need some engineered solution to discourage overflow waters from flooding the roads and houses nearby.

Potential funding assistance: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, re-engineering options possibly researchable by the U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might also be able to provide needed funding.

PROJECT 8: In the city of New Baltimore (see page 22), there is a shoreline area which experiences regular flooding. In this area, Base Street (in the area southeast of Front Street) has about 17 houses which are in the 100-year floodplain (Zone A3). The street is only 10 feet wide and access to the houses is extremely difficult in cases of flooding or emergency. Two of the houses in the area are identified as repetitive-loss structures by the NFIP, in which this community is a participating member. Sandbagging activities have been observed to try to protect other floodplain houses on this street from damages.

Possible mitigation strategies: The repetitive-loss property could be acquired or elevated. Emergency sandbagging efforts might be replaceable with some sort of flood wall.

Potential funding assistance: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, re-engineering options possibly researchable by

the U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might also be able to provide needed funding.

PROJECT 9: In the City of St. Clair Shores (see page 25), there are shoreline areas to the east of Jefferson Avenue that have numerous structures at risk from flooding—mainly when there are storm surges on Lake St. Clair or when lake levels are high. Thirteen of these houses had been proposed for elevation projects using the Hazard Mitigation Grant Program, but the project fell through. The houses are located in the 100-year floodplain (Zone A2). The base flood elevation at the lake front is about 582.5 feet, and many of these houses proposed for elevation have their first floors several feet below that mark. One of these houses has its first floor located nearly five feet below the base flood elevation. Some of the houses also have basements which would probably flood completely, such as one that also has its first floor 3.7 feet below the base flood elevation. There are five structures currently on the NFIP's repetitive-loss list that are located in the shoreline areas of this city. Every 2 to 3 years on average, flooding causes about \$15,000 damage to each of at least 5 homes in the area, with damage estimates of twice that amount in a 10-year event. The city is a participating member of the National Flood Insurance Program.

Possible mitigation strategies: Elevation or acquisition of structures that are below the base flood elevation. A structural solution such as a flood wall might be a cost-effective way to prevent shoreline and storm surge flooding.

Potential funding assistance: The proposed HMGP elevation projects might be revived if greater amounts of matching funds can be found from local sources, foundations, nonprofit organizations, or corporate giving programs. (Local homeowners were reportedly reluctant to have elevations proceed without reassurance that a means could also be found to finance related landscape, garage, and driveway alterations to accompany such projects.) The U.S. Army Corps of Engineers might be involved in a shoreline structural solution. The Flood Mitigation Assistance Program could be used for elevations or acquisition of specific houses that are at-risk. Local funding sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 10: An area in Ray Township (see page 23) at North Avenue and 29 Mile Road experiences flooding. There are 9 structures there that, in terms of their risks and the regularity of flooding, should currently be considered to be in a floodplain area. In the worst case, in February 2001, one of the houses had 6 to 7 inches of water in it. The community has joined the NFIP but not yet had its floodplain areas officially mapped for that program.

Possible mitigation strategies: Drain cleaning is apparently needed to the east of this area (see map following page 23) to discourage overflow onto the relatively flat lands nearby. Such drain cleaning throughout the township could alleviate many of its flood problems. Use of berms or flood walls in key locations could protect structures until such cleaning occurs, or if upstream developmental

effects render such cleaning insufficient. Improvements to the drainage system on and along North Avenue might also be appropriate.

Potential funding sources: Michigan Department of Agriculture Intercounty Drain Program or existing county drain maintenance funds. Local funding sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 11: The City of Warren (see page 27) reports that there is an area of relatively low elevation that experiences recurrent basement flooding, around Autumn Lane and Jane Court. There are about 10 or 12 houses there that have had waters of 6 to 12 inches in their basements. The area is not identified as a floodplain by the NFIP, but the community is a participating member in that program.

Possible mitigation strategies: Building public awareness of the need to keep water away from house foundations to discourage flooding; installation of basement sump pumps; adjusting footing drains in houses so that current ties into sanitary sewers will no longer cause flooding.

Potential funding sources: Existing public service announcement organizations, insurance companies, home improvement loan programs.

PROJECT 12: In the southeast section of the City of Fraser, there is an area of houses (see page 15) that regularly has one to two inches of water in their basements from flooding during annual rain events. With each episode of severe rain, there are about 15 to 20 houses that report such flooding to local officials, out of about 200 homes in the at-risk area. Although there is no way to tell precisely which of the 200 homes will be the ones to experience flooding next, it is predictable that some of these homes will continue to be affected in this way until mitigation steps are taken. The community is a participating NFIP member.

Possible mitigation strategies: Building public awareness of the need to keep water away from house foundations to discourage flooding, installation of basement sump pumps in homes. Drain improvements are currently being arranged by the city.

Potential funding sources: Existing public service announcement organizations, insurance companies, home improvement loan programs.

PROJECT 13: In Section 16 of Lenox Township (see page 19), 7 homes are susceptible to basement flooding, between Smith Street and 29 Mile Road. The community has joined the NFIP, but has not yet had an official floodplain map created for its insurance program.

Possible mitigation strategies: Building public awareness of the need to keep water away from house foundations to discourage flooding, installation of basement sump pumps in homes, dry floodproofing projects.

Potential funding sources: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, home improvement loan programs, insurance incentives.

Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 14: On the far eastern edge of New Baltimore (see page 22) is a house that has been identified as an NFIP repetitive-loss structure, located in a 100-year floodplain (Zone A3). It no longer appears on the current list, but because of its known damages, it has been scheduled for elevation once this plan is approved and adopted. The community is a participating NFIP member.

Suggested mitigation strategy: Elevation or acquisition of structure.

Potential funding sources: Flood Mitigation Assistance Program. Local funding sources, foundations, nonprofit organizations, corporate giving programs, or the homeowner(s) might provide additional funds necessary for the proposed solution.

PROJECT 15: Section 15 of Washington Township (see page 28) has two homes which recently suffered at least a foot of water in their basements. Since this flooding was the effect of runoff waters in that rapidly urbanizing area's particular topography, the area was not considered to be in a floodplain when the area was mapped for NFIP classification purposes. The community is a participating NFIP member.

Possible mitigation strategies: Drain cleaning or improvement to expand its capacity, or other structural projects to slow or divert the flow of runoff waters; sump pump installation in basements.

Potential funding sources: Michigan Department of Agriculture Intercounty Drain Program or existing county drain maintenance funds. Local funding sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 16: An area in Ray Township (see page 23) on North Avenue just north of 26 Mile Road was flooded, with 18 inches of water in the basement of a house when the East Branch of the Coon Creek backflowed into it in 2001. (It is an older house with no backflow preventer.) There are three houses to the southwest of this flooded one that should also be considered in at least a 100-year floodplain. The community has joined the NFIP but not yet had its floodplain areas officially mapped for that program.

Possible mitigation strategies: Installation of backflow preventer in home, structural flood protection or channel improvement project for the Coon Creek.

Potential funding sources: Michigan Department of Agriculture Intercounty Drain Program or existing county drain maintenance funds. Local funding sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 17: There is a house in Section 15 of Clinton Township (see page 13) that was on the NFIP's list of repetitive-loss structures. Although the home does

not appear on current lists of repetitive-loss structures, it has been approved for an acquisition project, upon approval and adoption of this mitigation plan. It was calculated that this acquisition would prevent more than \$5000 of flood damages per year. The structure is located in an area designated a Zone AE floodway, and the community is a participating NFIP member.

Suggested mitigation strategy: Acquisition of property for removal from floodplain, converting the area to open space uses.

Potential funding sources: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program. Local funding sources, parks & recreation funds, foundations, nonprofit organizations, and/or corporate giving programs, might provide additional funds necessary for the proposed solution.

PROJECT 18: Two houses on 34 Mile Road near the Mahaffy Drain in Bruce Township (see page 8) have experienced basement flooding as a result of area land developments and increased water runoff. The houses have installed sump pumps to alleviate this problem. Although minor damages have occurred, these houses are not located in an officially mapped floodplain area.

Possible mitigation strategies: Drain cleaning or improvement to expand its capacity, or other structural projects to slow or divert the flow of runoff waters.

Potential funding sources: Michigan Department of Agriculture Intercounty Drain Program or existing county drain maintenance funds. Local funding sources, foundations, nonprofit organizations, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 19: This project concerns houses in Section 27 of Chesterfield Township (see page 10), along Sugarbush Road, south of the high school. Although the area has been classified as between a 100 and 500-year floodplain (Zone B), there are 36 houses that have been assessed as higher-risk by local officials. Water floods around these houses to a depth of 8 to 12 inches, and residents have been observed using sandbags to prevent water damages to the structures. The community is a participating NFIP member.

Possible mitigation strategies: structural flood protection measures to replace sandbagging efforts; improved road drainage and use of retention basins; continued monitoring for worsening risk since some surface water retention may have been intended by the area's developmental design.

Potential funding sources: Existing county road or drain maintenance/improvement funds. Local funding sources, foundations, nonprofit organizations, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 20: In Section 32 of Chesterfield Township (see page 11) there is an area west of Jefferson and north of Anchor Road that has found it necessary to use sandbags to try to protect the structures there, which are all in a 100-year floodplain area (Zone A3). The structures are a party store, laundromat, and 17 homes. The community is a participating NFIP member.

Possible mitigation strategies: elevations of flood-prone structures might occur; the canal might be re-engineered to discourage flooding. A new pump station project (see page 32) should greatly help alleviate flooding to the at-risk properties along Jefferson Avenue.

Potential funding sources: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners or businesses (also business associations or economic development funds) might also be useful to assist with project funding.

PROJECT 21: In Section 22 of Chesterfield Township (see page 9), there are four apartment buildings that have nearby drainage back-ups that cause waters to come right up to the buildings. The buildings are in an area designated as between a 100 and 500-year floodplain (Zone B) on the community's FIRM, and many seniors live in the area. The community is an NFIP participant. Some local money is being generated and should be available to provide matching funds for grants or drain-cleaning activities.

Possible mitigation strategies: A retention pond, berm or wall might be used to keep floodwaters out of the at-risk buildings.

Potential funding sources: Local road or drainage authorities, other local funding sources, foundations, nonprofit organizations, involved homeowners, or corporate giving programs might provide additional funds necessary for some or all of the proposed solutions.

PROJECT 22: In the City of St. Clair Shores (see page 25), there are numerous structures located in floodplain areas (Zone B), whose risks can be exacerbated by wave action from the lake. There are an estimated 150 houses of this type in the area east of Jefferson around Statler Street (and several streets to its south). Other areas of the city may have similar problems (between 10 Mile Road and 13 Mile Road, east of Jefferson), but these houses around Statler have been identified by local officials as slightly higher priority due to their more vulnerable locations. Other at-risk shoreline areas include about 150 houses around Koerber Street south of Ardmore, and 150 structures east of Jefferson in the northern half of the city (in Zones A2 and B). The community is a participating NFIP member.

Possible mitigation strategies: Elevation of homes, structural solutions such as flood walls or re-engineered canals to prevent flooding from storm surges or higher lake levels.

Potential funding sources: Flood Mitigation Assistance, U.S. Army Corps of Engineers, Hazard Mitigation Grant Program. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 23: In Harrison Township (see pages 16-17), all of the structures located east of the Selfridge Air National Guard Base are in a 100-year floodplain area (Zone A2). Nearly all of these houses are near canals, the Clinton River, or

on the shoreline of Lake St. Clair. There are an estimated 351 houses and 10 other buildings in the area on the north side of the Clinton River. The community is a participating NFIP member.

Possible mitigation strategies: Elevation of homes, structural solutions such as flood walls or re-engineered canals to prevent flooding from storm surges or higher lake levels.

Potential funding sources: Flood Mitigation Assistance, U.S. Army Corps of Engineers, Hazard Mitigation Grant Program. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners or businesses (also business associations or economic development funds) might also be useful to assist with project funding.

PROJECT 24: As in Project 23, the eastern portion of Harrison Township (see page 17), south of the Clinton River, has many structures located in a 100-year floodplain (Zone A2). There are at least 569 structures in this area located east of Metropolitan Beach that are at-risk. The community is a participating NFIP member.

Possible mitigation strategies: Elevation of homes, structural solutions such as flood walls or re-engineered canals to prevent flooding from storm surges or higher lake levels.

Potential funding sources: Flood Mitigation Assistance, U.S. Army Corps of Engineers, Hazard Mitigation Grant Program. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 25: As in Project 23, there is a portion of Harrison Township (see page 17), south of the Clinton River and west of the Metropolitan Beach, that contains about 253 structures within a 100-year floodplain area (Zone A2). About 41 additional homes also have similar flood risks (exacerbated by runoff from street and stream) although their official classification is in a Zone B area whose meaning is somewhat ambiguous.

Possible mitigation strategies: Elevation of homes, structural solutions such as flood walls or re-engineered canals to prevent flooding from storm surges or higher lake levels.

Potential funding sources: Flood Mitigation Assistance, U.S. Army Corps of Engineers, Hazard Mitigation Grant Program. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 26: In New Baltimore (see page 22), a participant in the NFIP, there are about 18 houses to the south and southwest of those in Project 8 that are located in 100-year floodplain areas (Zone A3) next to the shoreline or canals. The houses are not all in the same area, but are located around 6 different streets. The community is a participating NFIP member.

Possible mitigation strategies: Elevation of homes, structural solutions such as flood walls or re-engineered canals to prevent flooding from storm surges or higher lake levels.

Potential funding sources: Flood Mitigation Assistance, U.S. Army Corps of Engineers, Hazard Mitigation Grant Program. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 27: In Section 28 of Chesterfield Township (see pages 10-11), there are about 17 homes along Wand Street and the Auvase Creek that are located in a 100-year floodplain (Zone A3). Local officials agree that the actual flood risks are significant, and that floodwaters have had moisture effects on elements of the homes and their furnishings, so actions are recommended to mitigate against future flood damages. The community is a participating NFIP member.

Possible mitigation strategies: Elevation of structures. Perhaps creek widening or the creation of berms or floodwalls could help prevent flooding.

Potential funding sources: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 28: The City of New Haven (see page 23) has about 10 houses that are located in a 100-year floodplain (Zone A6) and therefore are at risk for flooding damages. They are located in an area near the Shook Drain, Haven Ridge Road, and Clark Street. The city is a participating NFIP member.

Possible mitigation strategies: Elevation of structures. Perhaps drain cleaning or widening or the creation of berms could help prevent flooding.

Potential funding sources: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, U.S. Army Corps of Engineers, existing county drain maintenance/improvement funds. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 29: In Section 23 of Chesterfield Township (see page 10) there are two houses that are in a designated 100-year floodplain (Zone A3). Local officials consider these houses to be at higher risk of flooding. They are near the Salt River, south of Callens Road and west of Hooker Road, and the community is a participating NFIP member.

Possible mitigation strategies: Elevation of structures. Perhaps the creation of berms or floodwalls could help prevent flooding.

Potential funding sources: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program, U.S. Army Corps of Engineers. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 30: In Section 15 of Chesterfield Township (see page 9), there is a business located in an NFIP-identified 100-year floodplain (Zone A2), but whose flood risks are now reported by local officials to exceed those of that classification. The community is an NFIP participant.

Possible mitigation strategies: Elevation, relocation, or acquisition of the structure. Perhaps the creation of a berm or flood wall could help prevent flooding.

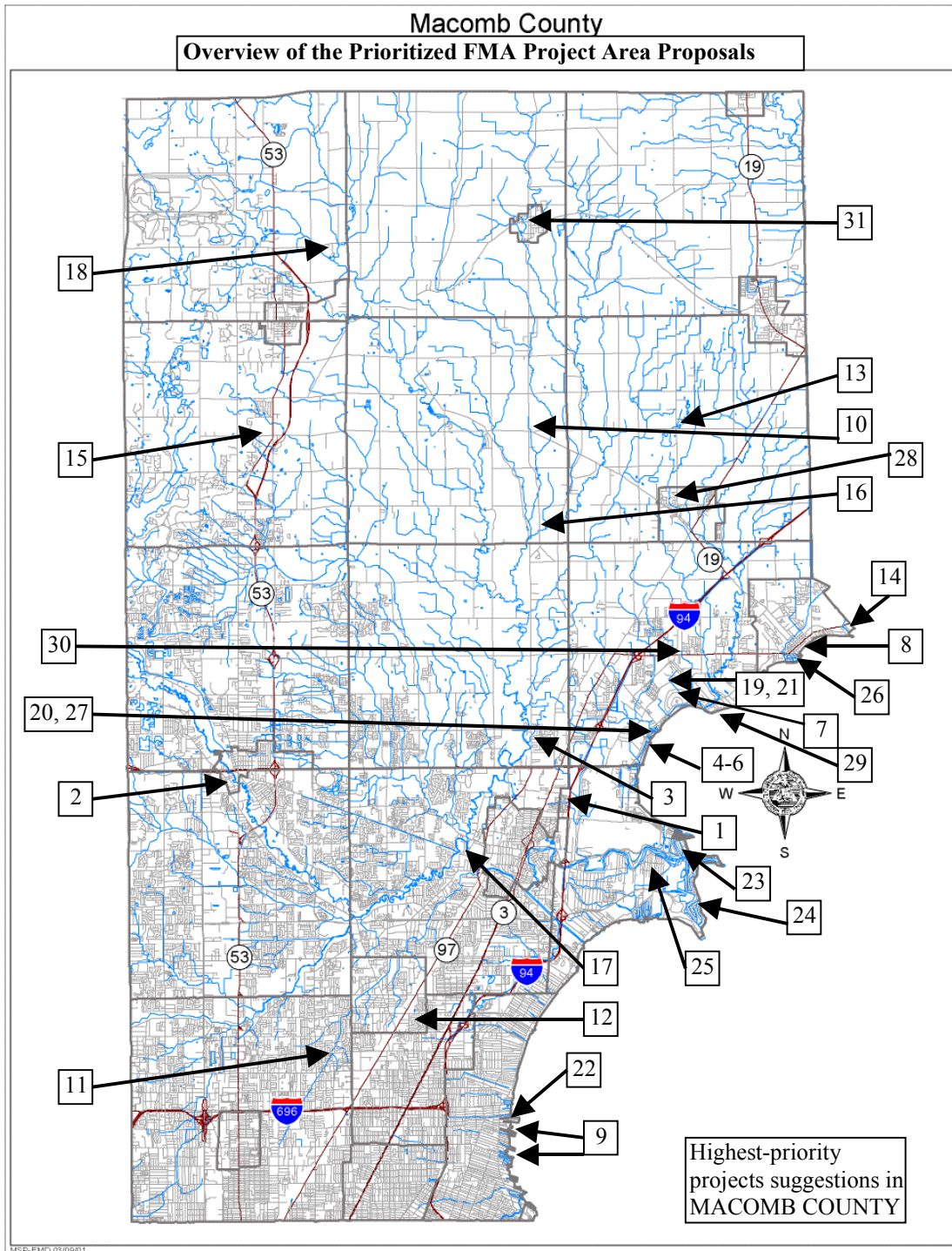
Potential funding sources: Flood Mitigation Assistance Program, Hazard Mitigation Grant Program. Local sources, foundations, nonprofit organizations, corporate giving programs, or involved homeowners might also be useful to assist with project funding.

PROJECT 31: A low-sitting house in the village of Armada (see page 7) is proposed for mitigation activities because ponding water in its yard goes right up to the back of the house during rainy weather conditions. The village is an NFIP-participating community and the house is located just outside the 100-year floodplain (Zone AE) on the area's Flood Insurance Rate Map.

Possible mitigation strategies: Creation of a nearby retention pond or berm to keep waters from collecting in the homeowner's yard. Floodproofing of the home would be helpful.

Potential funding sources: Hazard Mitigation Grant Program, Flood Mitigation Assistance Program. Local sources, foundations, nonprofit organizations, and/or the involved homeowner might also be useful to assist with project funding.

On the following page is a map showing the locations of all 31 of these prioritized project area suggestions for eventual FMA consideration. Some of these projects have already been reviewed by FEMA for Flood Mitigation Assistance project grants and are ready for implementation once this mitigation plan is adopted.



TRANSPORTATION INFRASTRUCTURE PROJECTS

TRANSPORTATION INFRASTRUCTURE PROJECTS

This "Focus Section" on flood hazards has identified numerous areas in which flooding slows or completely interrupts the use of various streets and highways throughout Macomb County. While these projects may not be eligible for funding from the Flood Mitigation Assistance Program, it is important that they be identified in this mitigation plan as worthy projects for consideration as other funding sources are identified and made available. The following is a list of the most important project areas of this type, listed in order of priority, as determined by traffic count information and history of flood severity. (For other, less pressing road problems, see the descriptions given for each community earlier in this document.)

1. Severe and recurrent road flooding along North Avenue in Macomb Township. This is the top-priority road flooding hazard in the county. North Avenue becomes impassible in some spots, and flooding extends for miles along it. Traffic counts in the south of the township are about 20,000 vehicles. In the middle of the township, traffic counts are about 14,500 vehicles, and in the north of the township, an average of about 7,000 vehicles use the road in a normal 24-hour weekday period. (see pages 20-21)
2. Ray Township road flooding on 26 Mile Road which can cause the road to close for several days, rendering it unusable to the average of 12,000 vehicles per day that otherwise would be there. In addition, aerial rescue was needed for motorists whose cars were stuck in the water. (see page 23)
3. Area of severe road flooding in Lenox Township on Lowe Plank Road between 30 & 31 Mile. Traffic averages about 7,500 vehicles per day, and since flood waters reach depths of two to three feet, the road experiences times when it is not safely usable. (see page 19)
4. Clinton Township area of road flooding on Clinton River Road. This road actually becomes unsafe to use during flood events. (see page 13)
5. Clinton Township area of road flooding at Groesbeck south of 16 Mile Road, with traffic averaging 36,000 vehicles per day. This flooding causes some delays but doesn't close the road completely. (see page 14)
6. Bruce Township road flooding over M-53. The traffic count along that area is roughly 18,500 vehicles per day, but it is assumed at this point in the analysis that the flooding merely causes traffic delays rather than requiring detours. (see page 8)

7. Flooding on northbound Gratiot within the city limits of Mount Clemens. The flood-prone area of the road averages traffic of about 17,300 vehicles per day but merely causes temporary delays to the traffic. (see pages 21-22)
8. Ray Township road flooding on North Avenue north of 29 Mile Road, threatening nearby structures and affecting an average of 8,000 vehicles per day that would use the road. (see page 23)
9. Road flooding on Gratiot Avenue north of 12 Mile Road, in Roseville. An average of 43,000 vehicles use this section of road per day, but since the flooding usually lasts for only an hour or two, the actual number of vehicles affected is about 7,000 during these events. (see pages 24-25)
10. Ray Township road flooding on 31 Mile Road over a length of about 2 miles. Although little-traveled (averaging only about 200 vehicles per day), the road has sometimes been completely shut down by this flooding
11. Clinton Township area of frequent road flooding at Kelly Road between 15 and 16 Mile Roads. Delays frequently result from this flooding. (see page 14)
12. Washington Township area with road flooding, major sheet flows of runoff water, and basement flooding. The road carries 2,500 vehicles per day, on average, but has not actually needed to be closed off because of this flooding. (see page 28)

Mitigation strategies for these areas of road flooding may include the following:

- Cleaning, reconstructing, widening, or changing the type of roadside drainage infrastructure serving the road.
- Improving the capacity of city sewers and associated drains that serve important roadways, including projects that separate storm sewer systems from sanitary sewer systems.
- Construction of water retention basins, where possible, to allow waters to drain off roads more quickly without overwhelming local storm sewer capacity or threatening nearby properties.

Potential funding sources for these projects include the Hazard Mitigation Grant Program, and existing sewer and transportation programs, budgets, and allotments. Other local sources, foundations, nonprofit organizations, corporate giving programs, or involved businesses and homeowners might also be able to assist with project funding.

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Information on NFIP Repetitive-Loss Properties in Macomb County